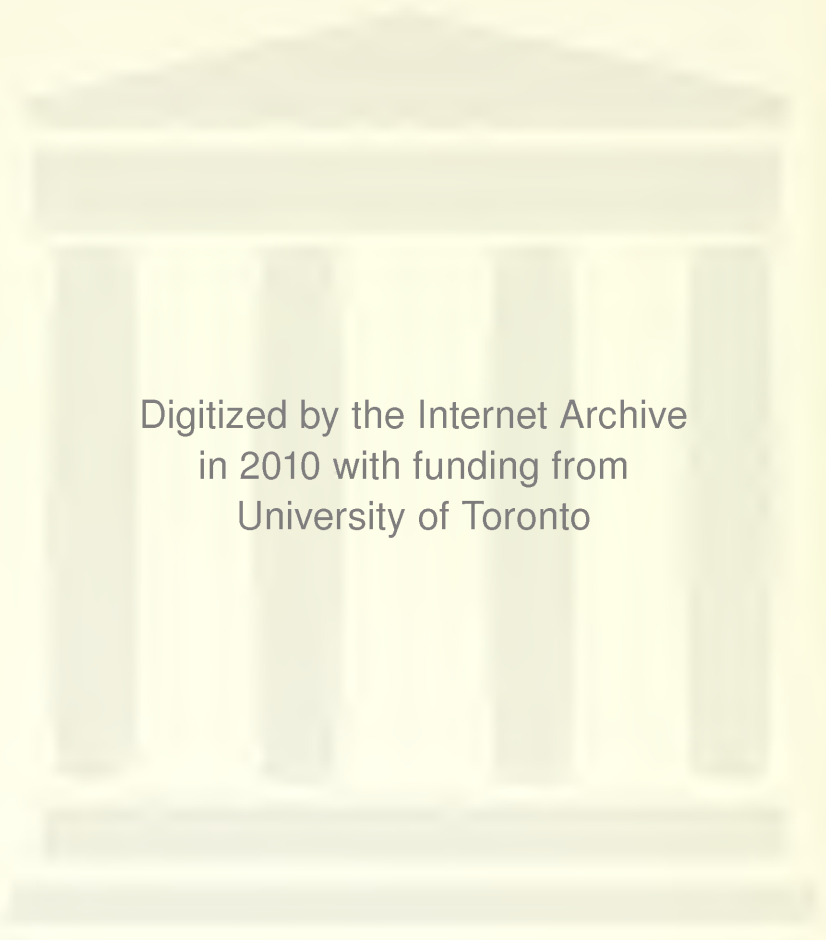


Digitized by the Internet Archive
in 2010 with funding from
University of Toronto

http://www.archive.org/details/canadianengineer07toro

(4)

THE CANADIAN ENGINEER

ESTABLISHED 1893

Issued Weekly in the interests of the Civil, Mechanical, Structural, Electrical, Marine and Mining Engineer, the Surveyor, the Manufacturer, and the Contractor.

Index to Volume (16) 7

(JANUARY-JUNE, 1909)
Aug. - Dec. 1909

The volume of editorial matter has increased to such an extent that it has been found necessary to issue indexes every six months. Henceforth a new index will appear in June and December.

104738
9/9/10

THE CANADIAN ENGINEER
Head Office, 62 Church St., TORONTO
MONTREAL WINNIPEG

TA
1
C 34
v. 7-8

The Canadian Engineer

INDEX TO VOL. VII.

Accidents of the month ... 164, 209
Acetylene Lighting, Progress of ... 214
" Gas Machine Patent in Court, An ... 247
" for Cooking ... 323
Aluminum, The Advance in ... 42
Amalgamating Apparatus, A New ... 15
Arc Lamps, Long Burning Enclosed ... 97
Armstrong Planer Tool, The ... 253
Architects' Association, Quebec ... 165, 209
Asphalt Block, The ... 146
Automobile Progress ... 22
" Trip, A Remarkable ... 41
" Notes ... 279
" Boom ... 65
" Electric ... 81
" Steam Power for ... 98, 185
" The McLachlan Electric & Gasoline Motor Co. ... 134
Axes and Saws, An Exhibition of ... 70
Battery, The Improved Samson ... 82
Bearings, Ball and Roller ... 320
Bicycle Combination, The Canadian ... 140
Bit, An Improved ... 46
Blue Process Paper ... 329
Boiler Compounds, The Use of ... 307, 317
Brief but Interesting ... 29, 58
Building Regulations ... 35
" Laws, Toronto ... 293
Calcium Carbide at Chicoutimi ... 330
Canadian Engineer, Good Work Appreciated ... 165
" Engineer ... 224, 254
" " Abroad, A ... 70
" Mining Institute ... 325
Canadian Pacific Ry., New Windsor street Station of ... 220
" Rand Drill Co., New Shops of the ... 252
" Asbestos Co, The ... 322
Canal, Ottawa Valley ... 46
Canals of Canada, The ... 245, 266
Carbide Works, Ottawa, Explosion at the Dominion ... 253
Carbon duties, Discrimination in ... 105
Catalogues, New 45, 112, 192, 232, 256, 276
Catch Basin, The Robertson ... 230
Cement Industry, The ... 127
" Beaver Portland ... 251
" Some Experiences with Portland ... 237, 255
Central Station Accounting from a Business Standpoint ... 102
Chain Blocks, Yale ... 45
Civil Engineers, Canadian Society of ... 14, 42, 230, 278, 294, 323
City Engineer, Victoria, B.C. ... 6
Clutch, Arnold Magnetic ... 302
Coal Seams, Notes on the Deposition and Development of the Glace Bay ... 305
Coke Works, The Everett ... 202
Combustion ... 273
Concrete, The Compressive Strength as Determined by Tests made at McGill University ... 156
Compressed Air Fizzle, That ... 127
Coupling, The Dart Union ... 111
Coke from Nova Scotia for Use on Railways ... 231
Copper Co., The Great Lakes ... 165
Correspondence Schools in Toronto, The International ... 220
Cranes, Electric Traveling ... 302
Culverts and Bridges ... 7
Dam Building ... 18, 51, 111
Distillation of Pan Dust, Destructive ... 213
Dodge Mnfg. Co. of Toronto ... 51
Draughting ... 197
Drill Grinder, The Yankee ... 141
Drill and Ratchet Screw Drivers, New Reciprocating ... 109
Drill, A New ... 50
Economizer, Green's ... 47, 192
Electric Currents, The Protection of Low Tension Wiring against Dangerous High Potential ... 95
" Power, Possibilties of the Ottawa Valley ... 94
" Railway, A Revolution of the Present System by the Advent of the Elevated ... 121
" Railway, Isle of Man Tramways ... 137
" Light Co.'s Works on the Chaudiere River, Canadian ... 159
" Lighting and Power Plant of the Victoria Hospital, London, Ont., The ... 300
" Flashes 28, 54, 77, 117, 142, 175 [208, 234, 260, 284
Electrical Association, Second Annual Convention of Maritime ... 20
" " Canadian ... 60, 84
Engine, The Peerless Self-Oiling Automatic ... 224
" The McEwen Automatic ... 319
" Large Compound ... 329
Engineer, Toronto, Report of the City ... 189
Engineers' and Electricians' Hand-Book, Reference Directory, The ... 201
" Club, Toronto, The ... 39, 301
Engineering and Maintenance of Way Association, American ... 330
Estimates, The ... 17, 301
" of the Dominion, Supplementary ... 83
Exhaust Head, A New Form of ... 189
Fire, The Tall Building Under the Test of ... 218
Fires of the Month ... 30, 60, 83, 112, ... 146, 210, 232, 262, 277
Fireproofing, A New System of ... 30
Firemen's Association, Ontario Volunteer ... 136
Fire Prevention Committee, The British ... 201
Fly Wheel Design, Improvement in, Cast Iron ... 19
Gas Engine, General Principles of ... 226
Gas Works, The Boston ... 313
Generating Set, A Substantial Type of Marine ... 222
Good Roads ... 251
Grate Bar, The Cyclone ... 250
Grand Trunk Railway, Portland Terminus of the ... 127
" Trunk Railway Locomotive ... 51
Great Britain, Hatred of, in Europe ... 276
" " Markets of Canadian Goods in ... 277
Greening Wire Co., Ltd., Origins of the B ... 200
Hawkes Brantford Adjustable Drop, with Roller Bearings ... 323
Heating, Hot Water ... 17, 38, 113
" and Ventilation, School ... 278
" " " ... 226
Hudson Bay ... 156
Ice Breaking ... 163
Imperial Oil Co ... 156
" " " and the Standard Oil Co ... 185
Industrial Notes 23, 53, 75, 115, 141, [173, 203, 233, 256, 281, 308, 331
Indicators, Speed ... 321
Iron Bounties, The ... 83
Iron and Steel, Canadian ... 65
" " ... 207, 236
" Production ... 19
" Methods, Swedish vs. Canadian ... 11
Lachine Rapids Hydraulic and Land Company ... 123
Lake Levels ... 264
Liquefaction of Air, The ... 5
Literary Notes 30, 52, 112, 140, 165, [198, 231, 256, 278, 312
Lubricators for Compound Engines ... 19
McDonald's Generosity, Sir William ... 210
McGill Prizemen in Applied Science '99 ... 45
Manual Training in the Public Schools ... 270
Marine Engineers, The ... 278
" News 26, 57, 81, 118, 145, 177 [205, 262, 286, 310, 335
Measures and Rules ... 288
Metal Imports from Great Britain ... 7 60, 83, 114, 148, 165, 197, 237, 288, 304
" Polish ... 14
Mechanical Draft, A test of ... 229
" " Upon the Ultimate Efficiency of Steam Boiler, The Influence of ... 48, 138
Meters and Meter Rates ... 66
Metric System, The ... 190
Mechanical Trades, Mathematics in the ... 241
Mineral Wealth of Newfoundland ... 221
Minerals, Ontario ... 277
Mineral Productions in 1898, U.S. ... 135
" " of Nova Scotia ... 41
" Industries of Ontario, The ... 160
Mining Matters 27, 56, 80, 118, 144, [177, 205, 236, 287, 311, 331
Mica in Quebec ... 46
Motor, The Deisel Heat ... 186
Motors, Direct Connected to Machine Tools, Slow Speed ... 321
Navigation in Canada, Lake ... 6
Nernst Lamp, The Proper Efficiency of Incandescent Lamps for Central Stations, Including a Description of the ... 99
Nickel Production, Canadian ... 33
" Extraction by the Mond Process ... 160
" Steel, Canadian ... 202
" " The Properties of ... 304
Oil Stones, How to Use and Select Them ... 275
Ontario, A New ... 213
Patents, Canadian ... 312
Pavements Between Street Railway Tracks ... 109
Peat as Fuel in Canada ... 202
Personal 20, 57, 81, 119, 145, 178, 205, [237, 259, 284, 335
Plumbers and Steam Fitters of Canada, The Nat. Asso. of Master ... 84
Power ... 158
Power Question, The Niagara ... 35
Practical Man, The 22, 53, 96, 163, [191, 232, 248, 271
Pulp Grinder, A New ... 330

PAGE

Pumping Machinery 254
Pumps, Interchangeable Oil ... 274
Railway Building in Manitoba. .. 274
" Engineering 111, 141, 249
" Matters 27, 57, 79, 119, 144, [179, 206, 236, 261, 286, 312, 333
" Subsidies 119, 137
Reed Mnfg Co. of Erie, Pa., The.... 195
Richelieu and Ontario Company's Steamer "Toronto" 73
Royal Electric Co., Ltd., The 112
St. Lawrence Levels 240, 264
" Route, The Beginnings of the.....1, 31, 61
Sandstone, Artificial 39
Sanitary Necessities 181
Sanitation in Schools, Modern 34
Scales, Suspension 23
Separators, The Austin Steam..... 159
Sewage Disposal, The Royal Commission on 15
" Disposal Works, Brockton, Mass 314
" Treatment, Septic Tank System of 192
Sewers of the City of London, Ont., The Construction of the Main Intercepting 43, 70
Smelter for Toronto 34
Smoke Consumption 111, 221
South Africa; Its People and Its Trade ...154, 182, 211, 265, 291. 314
Stationary Engineers, Canadian Association of.....84, 193, 231, 276, 301
" Engineers, Tenth Annual Convention of Can. Asso.....114, 128
" Engineers, Ontario Asso. of.. 83
Steam Trap 272
Steam, Advantages of Coke over Coal as a Fuel for Generating..... 195
" Turbine, Direct Connected, Parson's 169
Steel, Overstrain in 223
" For Building Construction, The Manufacture of 225
Stoker Co., American vs General Engineering Co 180, 277, 306
Surveyors, New Land 306
" Ontario Asso. of Land... 304
Technical School, The Toronto 312
Temperature ..... .248, 277
Toronto Exhibition Notes 164
Torsional Strains, Instrument for Measuring Small 9
Transformer Economy ..... .89, 102
Trap, The Interception 289
Trust Formations in the United States 41
Turbine Steamers, The 289
Vats, Leaking 111
Ventilating, Heating and 226
" " " " One Story Buildings 158
" " " " Fan A New Type of Electric Propeller 96
" " " " Howsh" Extra Heavy Combination Pipe 14
Water Curtain, The 192
Watermain Scraping 211
Waterpower and Its Electrical Production in Relation to the Undeveloped Resources of the Dominion Canadian 91, 124
Water Supply 203
" " Sand Filtration of Public 39, 71, 148, 171, 196
" " Works, Toronto 18
Waterworks and Sewerage Construction of the 203

PAGE

Workmen's Compensation for Injuries Acts..... 35
Wrench, The V. & B Pipe..... 111

CORRESPONDENCE.

Baillairge, Chas.—"Dam Building".. 18
Correspondent—"Water Pressure" .. 265
Diamond Saw and Stamping Works—"Canadian Engineer" 254
Engineer—"Excessive Heating in a Corliss Engine" 186
Fielding, John S.—"Dam Building".. 51
Fordyce, Jas.—"Canadian Engineer" 254
Green Fuel Economizer Co.—"Green's Economizer" 192
Hamilton, G. A.—"Canadian Engineer" 306
Hegan, James B.—"Canadian Engineer" 254
Hodgins, J. George—"Red Cross Fund" 307
Malmgren, Henry—"Heirs Wanted" 277
Murphy, J. F.—"Canadian Engineer" 254
National Carbon Co.—"Discrimination in Carbon Duties" 195
Petrolian.—"Petrolia and the Standard Oil Co." 209
Robbins, J. M.—"An Impoverished Philosopher" 224
Ronald, J. D.—"Canadian Engineer" 254
Roy, Alex.—"Canadian Engineer".. 254
Vessot, S. & Co—"Canadian Engineer" 254

PORTRAITS.

Beckett, F. G..... 15
Bertram, Surgeon-Lieut. T. A..... 114
Black, Wm. A 75
Colpitts, W. W 45
Dion, A. A..... 88
Esford, Capt. H. 74
Gildersleeve, C. F. 74
Gossler, P. G. 88
Grier, A. G. 45
Hutchison, W. S. 45
Hyde, Geo. T. 45
Kirkpatrick, S. F. 45
McLean, W. B. 45
Moseley, Chas. 133
Oelschlager, W. 132
Smith, Archibald W. 114
Trowern, P. 42

BIOGRAPHICAL SKETCHES

Beckett, F. G. 15
Bertram, Surgeon Lieut. T. A. 114
Black, Wm. A 75
Bunton, The Late Prof. 189
Durley, R. J., B.Sc. (London) 47
Esford, Capt. Henry 74
Gildersleeve, C. F. 74
Gossler, P. G. 88
Killey, The Late J. H 135
Moseley, C. 133
Oelschlager, W. 132
Smith, Archibald W. 114
Trowern, P. 42

CONTRIBUTORS OF SIGNED ARTICLES

Anderson, W. B.—"The Compressive Strength of Concrete as Determined by Tests made at McGill University" 136
Ardagh, A. G.—"Peat as Fuel in Canada" 92
Baillairge, W. F.—"The Construction of the Main Intercepting Sewer of the City of London, Ont." 43, 70
Baillairge, C.—"The Boston Gas Works" 313

PAGE

Baillairge, C.—"The Asphalt Block" 140
Cary, Albert A.—"The Use of Boiler Compounds." 307, 317
Cary, E. E.—"The Proper Efficiency of Incandescent Lamps, Including a Description of the Nernst Lamp." 99
Campbell, A. W.—"Culverts and Bridges." 7
Coker, E. G.—"Instruments for Measuring Small Torsional Strains" 9
Davis, A.—"Revolution of the Present Railway System by the Advent of the Elevated Electric Ry. 11, 12
Detwiler, J. B.—"Roller and Ball Bearings." 320
Dion, A. A.—"Meters and Meter Rates." 66
Drummond, Geo. E.—"Iron Production." 19
Eldridge, W. K.—"Some Experiences with Portland Cement." ...237, 255
Freeman, Arthur C.—"Advantages of Coke over Coal as a Fuel for Generating Steam." 195
Hartranft, Wm. G.—"Beaver Portland Cement." 251
Hart, P. H.—"Central Station Accounting from a Business Standpoint." 102
Kindl, F. H.—"The Manufacture of Steel for Building Construction" 225
Kirkpatrick, S. F.—"Notes on the Deposition and Development of the Glace Bay Coal Seams." 303
Keefer, Thos. C.—"Canadian Water Power and Its Electrical Product in Relation to the Undeveloped Resources of the Dominion." 91, 124
Lea, R. S.—"Sand Filtration of Public Water Supplies." 39, 71, 148, 171, 196
Leonard, F. H., jr.—"Transformer Economy." 89, 102
Morgan, C. E.—"Pumping Machinery" 254
Parsons, H. deB.—"The Tall Building Under the Test of Fire."... 218
Plaskett, J. S. "Mathematics in the Mechanical Trades." 241
Plews, W. J.—"The Protection of Low Tension Wiring Against Dangerous High Potential Currents". 95
Rust, C. H.—"Brockton, Mass., Sewage Disposal Works" 314
Rust, C. H.—"Pavements Between Street Railway Tracks" 100
Robert Austen, Sir William Chandler, "Nickel Extraction by the Mond Process" 100
Snow, Walter B. "The Influence of Mechanical Draft Upon the Ultimate Efficiency of Steam Boilers" 48, 138
Trowern, P.—"Measures and Rules" 288
Trowern, P.—"Power" 138
Trowern, P. "Hot Water Heating" 17, 38, 113
Turbayne, W. A.—"Long Burning Inclosed Arc Lamps" 97
Watson, W. M.—"The Interception Trap" 289
Watson, W. M.—"Sanitary Necessities" 181
Watson, W. M.—"Water Supplies" 3, 36, 151, 230 203
Weir, Arthur.—"The Beginnings of the St. Lawrence Route" 1, 31, 61

The Canadian Engineer

VOL. VII.—No. 4. TORONTO AND MONTREAL, AUGUST, 1899. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR, R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE.

Toronto Telephone, 1392. Montreal Telephone, 2589.

UNITED STATES AGENT:
H. E. BURNETTE, Cor. Fourth and Locust Sts., Philadelphia.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Automobiles, Steam Power for	98
Bertram, T. A., Surgeon-Lieutenant	114
Central Station Accounting From a Business Standpoint	104
Coupling, The Dart Union	111
Correction	111
Catalogues, New	112
Electrical Centre, An	94
Enclosed Arc Lamps, Long Burning	97
Electric Flashes	117
Fan, A New Type of Electric Propeller, Ventilating	96
Fires of the Month	112
Hot Water Heating	113
Incandescent Lamps for Central Stations, Including a Description of the Nernst Lamp, The Proper Efficiency of	99
Industrial Notes	115
Literary Notes	112
Mining Matters	118
Marine News	118
Metal Imports From Great Britain	114
Pipe Wrench, The V. & B.	111
Personal	119
Railway Engineering	111
" Matters	119
" Subsidies	119
Smoke Consumption	111
Stationary Engineers, Convention, Canadian Association	114
Smith, Archibald W.	114
The Practical Man	96
Transformer Economy	102
The Royal Electric Co. Ltd.	112
Vats, Leaking	111
Water Power, Canadian and its Electrical Product in Relation to the Undeveloped Resources of the Dominion	91
Wiring, The Protection of Low Tension Against Dangerous High Potential Currents	95

CANADIAN WATER POWER AND ITS ELECTRICAL PRODUCT IN RELATION TO THE UNDEVELOPED RESOURCES OF THE DOMINION.*

Canada with a small population and insufficient capital has nevertheless held a foremost position in the products of the forests and the fisheries, as well as in the quality of those cereals and fruits which attain their highest development in a northern latitude. In live stock she has not suffered by comparison with any other portion of this continent, while in dairy products she is pre-eminent. If she has not, until recently, made much progress in mineral development, it has been more from want of money than of mines. If she has been long in attaining a position as a manufacturing country, it is accounted for by the fiscal and financial conditions of a sparsely-settled country, the smallness of a home market, and the competition of greater capital and out-put, and therefore cheaper production elsewhere. Amongst the many partially developed resources of Canada, perhaps there is none more widespread or more far reaching in future results than her unsurpassed water power. The value of this has been enormously enhanced, first by the expansion of the wood pulp manufacture, and the introduction of electro-chemical and metallurgical industries for which this country possesses the raw material; and, more recently, by the revolution which has been brought about by success in transmitting the energy of water falls from remote and inconvenient positions to those where the work is to be done. Electrical transmission brings the power to the work, and when the prime mover is water, we have the cheapest power, and perhaps nearest approach to perpetual motion which it is possible to obtain—one which is always "on tap," and, like gravity, maintained without cost and applied without delay.

An examination of any good map of our broad Dominion reveals, as its most striking feature, an extraordinary wealth and remarkably uninterrupted succession of lakes and rivers, suggestive of ample rainfall, the first great requisite in the occupation of any country. This feature would be still more impressive if all the waters could be shown on the map. Over large areas only the more important rivers have been explored and delineated; while in the surveyed districts many are necessarily omitted to leave room for other information to be given. These rivers and lakes have been the most important factors in the settlement of the country, as they formed the earliest lines of approach for the penetration and exploration of the interior, and for the exploitation of our forests. The lumberman followed the trapper and the fur trader, the axe supplanted the rifle, and thus the country was opened up by men who knew not only where to begin, but, by their calling, were best equipped as pioneers. The frontier, where not already occupied by the French, was necessarily rapidly settled in the first place by the Loyalists of 1776, who could not stand upon the order of their departure after their homes were confiscated. These found the rivers their earliest friends, from whence they obtained the means of shelter and of employment in the only industry by which money could then be obtained, viz., the floating of timber and potash to Montreal and Quebec.

Over a length of several thousand miles between Labrador and Alaska and over a width of several hundred miles, there is an almost continuous distribution of lakes, lakelets and rivers—the lakes of varied outlines, dimensions and elevations above sea level, and many possessing facilities for the storage of their flood waters. This power of storage has been largely taken advantage of by lumbermen to retain the needed supply for their spring "drive," into the main stream. In many places the outlet from the lake, or the connection between a chain of lakes, is a narrow cleft in rock where an inexpensive dam will hold back the water supplied by the winter's accumulation of snow. With the exception of her prairie region, the rivers of Canada differ from the Mississippi, Missouri, and Ohio, and the larger part of their tributaries, in that they are not naturally navigable from their mouths, or above

*Presidential Address read before the Society, May 23rd, 1899, by Thos. C. Keefer, C.M.G., President of the Royal Society of Canada.

tidal influence to any considerable extent, except in detached sections; while the former are navigable for thousands of miles and are therefore without water power. Those great western rivers flow upon a nearly uniform grade of a few inches per mile, whilst the St. Lawrence and its tributaries are interrupted by rapids, chutes and cataracts, affording a great variety, quantity and quality of water power.

In the United States, between the Atlantic coast and the Rocky Mountains, as far south as the Gulf of Mexico and as far north as the Dakotas (with the exception of part of New York and New England), there is an entire absence of lakes; while throughout Canada, north of the St. Lawrence and stretching north-west toward the Mackenzie river basin, these are innumerable, in fact have never been numbered, and thousands of the smaller ones have never been represented on any map. The upper sections or sources of most of the Canadian rivers are chains of lakes, occupying in many instances the greater portion of the water course. These head waters are often upon nearly the same elevation and interlocked with the sources of other rivers flowing in opposite or different directions, and separated by narrow necks of land at a low divide, rendering diversion from one to another possible, a feature which has in some places been utilized by lumbermen—fearless of any legal injunction. This terrace-like profile of the rivers and their frequent expansion into lakes, often dotted with islands, not only enhances the beauty of the scenery, but, for utilitarian purposes, constitutes a series of elevated natural mill ponds, containing latent power of unknown extent and value, awaiting that demand upon them which is now being made in consequence of the discovery that our second-rate forest growth which has hitherto served chiefly to ornament their shores and islands has become the most important, and can be ground into pulp and rolled into paper to meet the ever-increasing demands of the newspaper, the bookmaker, and the innumerable forms into which wood pulp can be compressed for useful or ornamental purposes—or as a substitute for wood or metal. These steps from high to lower levels in every rivulet, branch, tributary or main stream of nearly every one of our northern rivers produce more or less broken water which never freezes over but remains open during the coldest weather, giving an alteration of closed and open water sections, of ice-covered lakes and of broken water in rapids, which may cover miles in extent, as well as at chutes or cataracts with more or less open water above and below them.

It is an interesting question for specialists to determine what effect, if any, this often large percentage and almost general distribution of open water during the coldest weather (of which every stream large or small has a portion), may have in modifying the extremes of temperature in these northern latitudes. When all the ground is frozen solid and covered with a deep mantle of snow, extending over the lakes and checking increasing thickness of their ice covering, large bodies of water are impounded and maintained at a temperature above the freezing point, although there may be fifty degrees of frost in the air, and are constantly poured forth into this frigid atmosphere. It is conceded that our Great Lakes modify the temperature of their border lands, and although these open water spaces in our northern rivers may be inferior in surface, they exist on every river having rapids or falls, and extend over such a vast field that their aggregate area must be very large. Unlike the Great Lakes these open spaces are constantly receiving fresh supplies of warmer water to temper the severity of the air. Such "breathing holes" (as they are sometimes called), are necessarily comparatively shallow, and are the only places, after all other water is frozen over, where "anchored" ice is formed and found. This differs from the lake ice in that the latter melts where it freezes, while anchor ice, when compelled by milder weather to let go its hold upon the bottom, rises, and is immediately drawn under the fixed ice below, and does not dissolve until the river breaks up in the spring. The latent heat of water disengaged in freezing—which process occurs so frequently during the five months of winter—is imparted to the atmosphere, but is not again absorbed by melting ice, as would be the case in lakes, or in deep, sluggish rivers. Again radiation is supposed to play an important part in "anchoring" the floating particles of ice to the river bottom, which is said to be cooled so rapidly by the ice-laden current above it as to become frozen, and then begin to attract the passing ice needles, and fix them to its bed. If mother earth, in mid-winter, contributes any of her impounded heat to the outer atmosphere, these almost innumerable unfrozen spaces certainly offer great facilities for giving vent to her suppressed emotions.

From the Straits of Belle Isle to Montreal, and thence ascending the Ottawa, the tributaries of the St. Lawrence and of the Ottawa descend, through the Laurentian region, from elevations of 1,800 to 1,000 feet above tide, and debouche within a few miles of each other, except immediately about the Saguenay. In many cases they bring their principal cataracts very near their outfall, notably in the case of the famous Falls of Montmorency, which, leaping directly into the St. Lawrence from a height of 250 feet, are utilized to light the streets and drive the tram cars of Quebec. Somewhat similar conditions exist on the south shore of the St. Lawrence until the Richelieu river (the outlet of Lake Champlain), is reached, where at Chambly, water power is about to be used to send the electric current into Montreal, in competition with steam, and with a similar water power from the Lachine Rapids. The divide between the St. Lawrence and the Ottawa is studded with lakes west of the Rideau Canal, a principal outlet for which—on the south—is the river Trent discharging into the Bay of Quinte, with large mills and much undeveloped water power at its mouth; and on the north, some half a dozen important tributaries discharging into the Ottawa. At Sault Ste. Marie, a water power canal fed from Lake Superior supplies the largest pulp mill yet erected in Ontario, and a similar work at the Lake of the Woods (which lake is 1,000 feet above tide), gives power to the largest flour mill in the Dominion. The waters of the Winnipeg river (the outlet of the Lake of the Woods), descend about 300 feet, unused, into Winnipeg Lake, adjoining Lake Manitoba, from whence the water system extends to the Saskatchewan, and thence via Athabasca, the Great Slave, and the Great Bear lakes, to the Arctic circle.

No reference has been made to the long established

water power in the older districts, on the Saguenay, or those between Montreal and Quebec, and upon the Ottawa, nor to the more recent and extensive pulp and paper establishments—it being the object of this paper to draw attention to the continuity and broad distribution of water power across the continent, on Canadian territory, and to the unnumbered natural reservoirs of water at elevations which impart to them latent powers for the future development of this country. British Columbia has not been included in this field, because its occupied portion is separated by our great prairie region from the lake system of Eastern Canada, which system is deflected toward the North-West at the Lake of the Woods. This province is by no means deficient in water power, although it has been little used as yet where mines are on high levels, and because steam could be more readily applied. On the other hand, it is the only province in which hydraulic mining is in operation; and where gold is found in quantity sufficient to warrant the great outlay of capital necessary in connection with that system. In the Kootenay, water wheels, with or without electrical transmission, are necessary for water power, in order to mine, pump, and crush the gold-bearing rocks; but in the Cariboo district, water power is applied in the simplest form, without wheels or wires, by direct pressure from a nozzle, as is done in Ottawa from a fire hydrant While the mountains south of the Canadian Pacific Railway are rich in metallic veins, the region north of this railway, extending into the Arctic Circle, appears to be a veritable land of Havilah, a continuous "Placer" gold field, in which much of the precious metal is to be obtained by hydraulic mining, wherever that is practicable.

This gold field, over a thousand miles in extent between the Fraser and Yukon rivers, and of unascertained width, has been exploited at Cariboo, (from whence fifty million dollars has been taken), at Cassiar and Omenica, and recently at Atlin, all in British Columbia—as well as in the far-famed Klondyke, in the Yukon district, said to be the richest gold field in the world. Water, in whatever way it is used, is necessary to the recovery of this gold, but in many places water power alone will profitably unearth it from its hidden recesses. This is collected in quantity from lakes, and reservoirs on the high levels, and carried for miles by ditches, aqueducts and flumes, to the banks of a primeval, deserted river channel, at the bottom of which, under forest-covered clay banks, lies the auriferous gravel studded with boulders and resting on the bed rock. Under a head of about 300 feet "six-inch rapid fire," hydraulic guns are pointed against the bank, breaking down the earth, uprooting trees, scattering boulders and washing out the gold—which remains in the traps set for it in the bottom of the sluices after all else has been carried off by the power of the water. These "machine guns," called "giants" and "monitors," are models of simplicity as well as of ingenuity and efficiency. While working they are great consumers of water—and can only be used when the ground is unfrozen, but this season is generally sufficient to use up all the water which can be collected at the necessary elevation. It requires at least two men to hold and direct the force of the issuing stream from an Ottawa fire hydrant, but a boy can direct the movement of a stream, twenty times greater in quantity and fifty per cent. stronger in pressure, as it rushes forth from the nozzle of one of these "giants"—which is fixed to a loaded platform, and moved forward as the bank in front of it melts away. A thin, short tube, of larger diameter, projects beyond the nozzle to which it is fixed by trunnions, so that the tube can be moved independently, both horizontally and vertically, to touch the issuing stream, which immediately recoils from the obstruction moving the "giant's" nozzle in the opposite direction. Thus a boy "behind the gun" can control its movement and compel the "giant" to fall back upon his own resources for motive power.

It is impossible to give anything but an approximate estimate either of quantity or value of the available water power over so vast an area, becuse the first would involve the survey of every power site; and, as to the second, the value begins when the power is wanted. All which now can be done is to state the conditions and endeavor to estimate the quantity, hypothetically. What is needed for an estimate is the quantity of water and the amount of fall which can be relied upon at the site for each power. To get the first, a measurement of the minimum flow at each point would be necessary in low water years, and for the second, some local knowledge as to river levels, back water, etc. In the absence of such surveys we must fall back upon the average rainfall of the whole region as far as that can be procured for any time, and assume the proportion of this precipitation (of rain and snow), which, after deductions for evaporation, the demands of vegetation, or infiltration, would reach the wheels. An allowance must also be made for that portion of the rainfall which may be carried off in floods. The area over which this precipitation would be in reach for water power purposes would embrace all the main land of Canada south of the St. Lawrence as well as all north of it in the St. Lawrence valley, and so much of the Hudson Bay watershed as can be utilized, or imported by transmission. As regards the power of the water thus estimated, we must embark in a much more speculative estimate as to the average fall which should be assigned to it for the whole region. We have in the undeveloped districts some scattered meteorological observations to assist us in estimating probable rainfall, and we have also a few barometrical observations giving the height above sea level of summit waters. On lower levels we have more numerous rain gauges, and summit levels ascertained by railway surveys.

For the whole river the total fall may be less than 100 feet, as in the case of the French river, which has Lake Nipissing for a mill pond, or rise to 1,500 feet or more as at the rivers below Anticosti. In the case of the French river (which is the lower part of a longer stream), we have surveys, and know that its whole fall can be utilized, as would be done if it is made navigable by locks and dams. In the others (where no surveys have been made), some will be more or less like French river, while at others only a portion of the total fall upon them may be profitably utilized. The most valuable will be those which, like Montmorency, bring all their water with sufficient head to the point where it is worth most. The upper sections of the rivers will be the least valuable, as having less water and being more remote until reached by a new railway, or a

transmission wire. We can therefore only state a hypothetical case especially as to the power to be assigned to the available water. Where the rainfall is known, the proportions which reach the streams have been ascertained, in the construction of reservoirs for water supply and other purposes. The chief difficulty with respect to the quantity of water is the want of rain gauges over so great an extent of unoccupied territory. Assuming therefore an average annual precipitation of twenty-four inches and taking one-half of this as available for water power, every ten square miles would yield an average of nearly one horse power for every foot of fall. A million square miles (and there is much more), would give nearly 100,000 horse power for every foot of fall; as there would be several hundred feet of fall which could be utilized, our water power must be immense—and commensurate with this country in other respects.

The above applies only to the tributaries of the St. Lawrence and the Ottawa, and to the Hudson Bay watershed so far as that may be utilized. The Canadian portion of the water power of the St. Lawrence, from Lake Superior to Montreal, in which there is a fall of 546 feet, is not included, being below the level of the tributaries. We have measurements of the flow in both the St. Lawrence and the Ottawa in cubic feet per second, as follows:

	c. ft. per sec.
In St. Mary's river, outlet of Lake Superior.....	80.000
In St. Clair river, outlet of Lake Huron.....	225,000
In Niagara river, above the falls.....	265,000
In St. Lawrence river, above the rapids.....	300,000
In Ottawa river, above Lake of Two Mountains...	35,000

Canada's share of the St. Lawrence water power from Lake Superior to Montreal would be about ten million horse power. Canada has half the water of the St. Lawrence from Lake Superior to Cornwall, and all of it between Lake St. Francis and Montreal; but only a portion of this half could be utilized—and this would apply more or less to the Ottawa and other rivers, where all the power could not be utilized without an expenditure probably beyond its value. The power at Niagara has been estimated at seven million horse power, from less than half of the fall between Lakes Erie and Ontario, but the flow of the Niagara river, as given above, does not support so high an estimate. The whole of this fall (over 320 feet), can be utilized on the Welland Canal, but the quantity is comparatively insignificant, from the limited channel and necessarily low velocity of the current in it. In like manner the whole fall upon our canals in the St. Lawrence can be utilized subject to the limitations imposed by the requirements of navigation. Because these canals have not had the work for which they were intended, they have in some cases become mill races rather than slack water channels. This has been the less felt, hitherto, on account of the lightness of their west-bound traffic, the strong current toward the mills being in favor of the deeper laden east bound craft, thus incidentally compensating for a violation of canal maxims.

While water power was at first the only substitute for the windmill in new countries, and its economy as well as superiority has always been recognized, several causes have contributed to limit its more general application. Before the invention of the turbine in the first half of the present century, heads exceeding about seventy feet could not be utilized on account of the comparative weakness and excessive cost of wheels of large diameter. In these days of structural steel, and "Ferris" wheels, this difficulty could be overcome; but, with the turbine, the conditions are reversed, the higher the head the less the size and cost of wheels, so that the most valuable water powers were the most cheaply utilized in this respect. A previous check to greater extension of water power was given in the latter part of the last century by James Watt's discovery of the steam engine, which by bringing the power to the work, to the city, and to the mine, revolutionized industrial conditions. A still greater revolution has recently occurred which brings water power to the front again, by its amalgamation with electricity, whereby its economical power is transferred to the work, over many miles of distance, upon a single wire. Within the last ten years high voltage electricity has been firmly established with annually increasing power of extension, and this has brought Canada into the first rank of economical power-producing countries. Water is thus represented by a power to which it can give birth, but which is superior to its own, in that, wherever transplanted, it can do nearly all the parent power could do, as well as give light, heat and greater speed; moreover it has given rise to industries only possible with abundant cheap electricity. What is more important to us is that such industries are those for which Canada possesses the raw material, but which, without water power, she could not engage in. There are important industries in which we have for some time utilized water power, for which electricity is not indispensable; but which equally require large amounts of cheap power, and are capable of indefinite extension: but while these may not need the intense electric current necessary for electro-chemical industries, they will find electrical transmission of inestimable value in many situations; while, for lighting and heating purposes, water power is invaluable to all. Heretofore we have cut our spruce into deals and exported it to Europe, and more recently into pulp wood and exported that to the United States; but, manufactured by our water power into paper, the raw material would yield this country ten times the value it is now exported for. The extension of railways, combined with electrical transmission, will promote the local manufacture of such wood products (including all valuable hardwood), as can bear transportation; thus giving the largest amount of local employment, as well as tonnage to the railway; and delivering us from the position of "hewers of wood" for other countries.

(To be continued).

AN ELECTRICAL CENTRE.

We speak of the natural resources of Canada in a vague way as we do of the sands of the sea, and with no more clear conception of what we are saying. It is sometimes a surprise to us when something comes up which gives us a more definite idea of what are our resources. Such is the map issued under the authority of the Board of Trade of Ottawa, which shows that within a radius of 45 miles from Ottawa city there is water power which at low water amounts to 917,693 h.p., and at high water to 3,317,630 h.p. Of this half a million h.p. (maximum flow), is within four miles of

the centre of the city. The rest of this vast power is distributed over the territory surrounding the city in about 42 units of from ten to one hundred thousand horse power. The compilation of the water powers in the area included in this map are from reports, estimates, and information given by the following gentlemen at the request of the Ottawa Board of Trade: T. C. Clark, C.E.; Walter Shanley, C.E.; Thomas C. Keefer, C.E.; George P. Brophy, C.E.; Robert Surtees, C.E.; Henry A. F. McLeod, C.E.; Frank A. Hibbard, C.E.; David Scott, C.E.; Henry Carre, C.E.; Andrew Bell, C.E.; J. H. Matte, C.E.; Andrew Holland, Ottawa; George L. Dickinson, Manotick; Alex. McLaren, Ottawa; W. C. Edwards, M.P., Rockland; R. McRitchie, Bryson; J. A. Cameron, Thurso.

A feature of these water powers, which makes them very valuable, is that almost all are so situated as to have many lake expansions, and all offer opportunities for the creation of artificial reservoirs so that the mean flow may be made regular. In many cases these dams have been already built by the lumbermen and are very important works; one on the Gatineau river gives a depth of five feet in a lake 30 miles long. To those who think of Ottawa as either the Washington of the North, or the seat of the lumber trade, we must point out that both are correct but incomplete descriptions of that city. It is the centre of a very rich agricultural and mineral country, and in addition to its lumber manufactures must very soon take a leading position in other lines of production. On every side of the city iron mines of great value are found. At Ironsides, to the North of Ottawa, one of the earliest attempts at iron smelting was made, but it was found unprofitable, and abandoned. At Bristol, to the West are iron mines which are very rich and have successfully shipped ore in spite of adverse duties in the United States. At Calabogie, to the South-west, is an iron mine which was sold for $100,000 a few weeks ago. These are all within the 45-mile radius, and all have communication by rail with the city. Some ten miles up the Ottawa river beyond this line are situated the galena mines, which have attracted so much attention in the past two years, and are now being profitably worked. Here are also four water powers on the Ottawa river aggregating one million horse power. In the electrical age, as next century will probably be called, Ottawa will undoubtedly be one of the industrial centres of the continent.

THE PROTECTION OF LOW TENSION WIRING AGAINST DANGEROUS HIGH POTENTIAL CURRENTS *

BY W. J. PLEWS, MONTREAL.

All persons in connection with electrical supply companies, especially in lighting service by alternating currents, have long recognized the necessity of some reliable apparatus to prevent low tension service wires inside buildings from becoming a possible source of danger to human life, or as regards fire, in event of contact with high tension conductors. That this condition often exists, and that the danger therefrom can hardly be overestimated, is a well known fact to all electricians who have had experience with alternating current systems. Some years ago, the principal element of danger was the liability of transformers to break down between the primary and secondary coils. Of late, however, conditions have changed considerably, the more recent types of transformers being a vast improvement on the older ones. While the contingency as regards transformers is not now so great as in former years, the change in the system of secondary distribution involving as it does the use of large secondary units and a net-work of wires covering a great area, has given rise to another and if anything a more important element of danger, namely, the increased liability of accidental contact between high and low tension conductors. This change in secondary distribution has been rendered necessary from an economical standpoint, and as it is not at all likely that anyone will revert to the old system, the proper course seems to be the protection of individual equipments. The contingencies previously mentioned have proven a frequent cause of fire, and in some instances have resulted in fatal accidents. Recognizing these dangers, various earthing devices have been contrived to cope with the difficulty. It seems, however, that the idea has been to afford protection from the breaking down of transformers only, by means of blowing the primary fuses, the inventors apparently not having taken into consideration the contingency of accidental contact between local and foreign conductors, whereby a large volume of current at a high potential may flow over the secondary apparatus and destroy both it and the protective device, in which event the protective device itself would probably become a source of fire. Several of the cases which have come under the observation of the writer, wherein conditions as mentioned have existed, have been of such a nature that any earthing device, depending upon the blowing of a fuse for its action, would have been a positive fire hazard. One instance in particular was a cross between a fallen secondary and a trolley wire. In this case had there been any device of the type mentioned, a volume of current would have flowed through the apparatus sufficient either to destroy it or blow the secondary fuses; this latter occurring, it is reasonable to assume that the high tension current would have maintained an arc across the terminals of the cut-out (one such as generally used for low tension wiring), and produced disastrous results. As far as the writer's knowledge extends, the principle, common to all safety devices of this nature, heretofore developed, has been to disconnect the local system from the source of danger by means of blowing fuses. This principle appears to be radically defective, the blowing of a fuse under such conditions being an uncertain element, attended at times with undesirable results.

In any apparatus designed to protect local low tension systems from currents of higher potential than they are constructed for, or expected to carry, it would seem more rational to employ a device that will automatically and instantaneously disconnect the high tension current from the low tension system to be protected, without depending upon the uncertain action of fuses. It is also believed that a device of this nature should be one in which the amount of current necessary for its successful operation is a known quantity, and that this quantity be as small as possible, so as to avoid dangerous arcing. Considering the matter from this point of view, the writer believes that an apparatus can be constructed which will embody the desirable characteristics, and it is to this possibility that your attention is respectfully invited. One form of such an apparatus, which is on exhibition here, is similar in action to a double pole knife switch, and is so constructed as to automatically open the circuit instantaneously, whenever the low tension wiring is brought into connection with conductors charged with dangerous high potential currents, either through a break-down in a transformer, or a cross between secondary and primary, or other high tension conductors. The great advantage claimed for this apparatus is that no matter how large the volume of current may be, only a small fraction is required to operate the device, and this only for an infinitesimal period of time, the device in opening disconnecting both the safety apparatus and the interior wiring from the outside source of danger. Another advantage is in the fact that the device provides special facilities for rapidly testing the local system for grounds, without the use of other apparatus. During the past few years many fires have originated from high potential currents accidentally traversing secondary systems and breaking down the insulating joints which intersected the junction between fixtures and gas pipes. From the manner in which first-class electric light wiring is installed at the present day, it would seem impossible for a current at a potential of say two thousand volts, to cause a rupture between secondary wiring and ground, and the writer's experience leads him to the conclusion

*From a paper read before the Canadian Electrical Association.

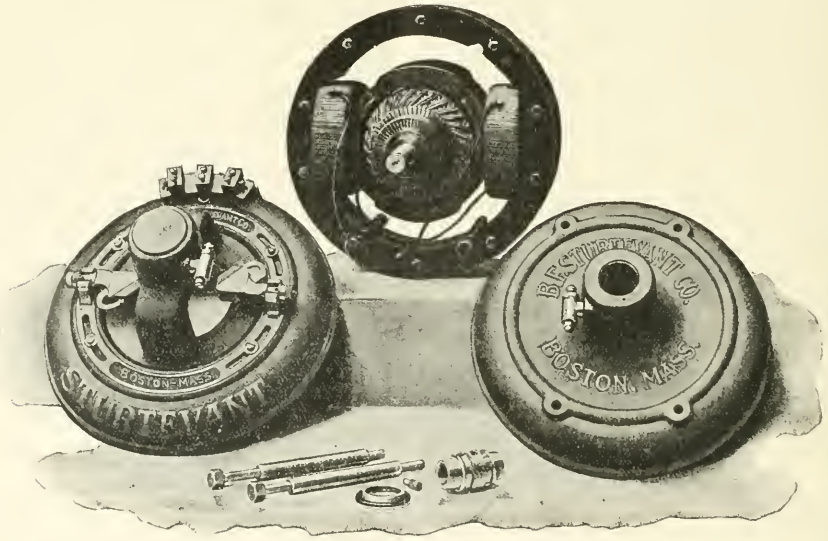
that if the so-called insulating joints properly performed their function, fires from this cause would be extremely rare.

If on the other hand low potential systems are so arranged that there is no chance for high potential currents to rupture to ground, there remains the danger of some person receiving a fatal shock while handling the apparatus. In view of these facts, it would seem advisable to equip all low potential systems, which are exposed to the contingencies herein mentioned, with an automatic device that in time of need will operate effectively.

A NEW TYPE OF ELECTRIC PROPELLER VENTILATING FAN.

Since the B. F. Sturtevant Co., of Boston, Mass., has entered extensively upon the manufacture of electric motors and generating sets, it has been carefully studying the problem of the manufacture of a compact, efficient and convenient type of electric ventilating fan. Exhaustive tests were made with different types of fan wheels. The result is made clear by the accompanying engravings, showing views of one of its electric ventilating fans, which have just been put upon the market. The fan wheel has eight blades rigidly attached to a spider at the

centre, and held in place by a hoop at the periphery, at an angle of approximately 30 deg. The angle is increased in such a manner that as the centre is approached the theoretical velocity of the air remains practically constant. In other words the delivery edge is helical, and the air is picked up on the inlet edge of the blades at low velocity. When well under the influence of the blades, it is accelerated to its maximum velocity with the least amount of slip. The result is an extremely efficient wheel. The motor likewise has been the result of very careful study in the attempt to provide a light machine, entirely enclosed, and at the same time to avoid the excessive temperature which is incident to the operation of most enclosed motors. The result is a machine capable of continuous operation for ten hours, with a maximum temperature rise of not exceeding 30 deg. F. A practical efficiency of over 80 per cent is obtained even with the small sized motors, and an excess load of 75 per cent. above the rated capacity may be carried without sparking, and without changing of brushes. This feature, combined with the small temperature rise, allows of carrying temporary overloads with impunity. The bearings are self-oiling and self-aligning, and are fitted with phosphor-bronze sleeves, which are



removable from the outer ends of the boxes. The wheel is partially enclosed in a conoidal inlet ring, which decreases the frictional resistance to the entering air, and furnishes at the same time a rigid support for the motor, to which it is attached by the tripod hanger. These fans are built in sizes from 18 inches to 120 inches, with motors designed for either medium or maximum speed, and to run at any ordinary direct current voltage. A speed controller is always provided by means of which the fan can be efficiently operated at different speeds.

THE PRACTICAL MAN.

To find the proportions of a toothed wheel.—Pitch of teeth = circumference of pitch circle ÷ number of teeth; number of teeth = circumference of pitch circle ÷ pitch of teeth; circumference of pitch circle = pitch of teeth x number of teeth.

To find the diametral or Manchester pitch.—Divide the number of teeth in wheel by the diameter of pitch circle in inches.

To find the angular velocity of a wheel.—(1) Multiply the circumference of wheel by number of revolutions it makes per minute and divide by 60 = linear velocity in feet per second; divide linear velocity by radius of wheel = angular velocity. (2) Multiply number of revolutions per minute of wheel, 360°, and divide by 60 = angle described by wheel in one second; divide this angle by 57.296 = angular velocity.

To find revolutions per minute of a driving or following wheel or disc.—Revolutions of driver x revolutions of follower x diameter of follower ÷ diameter of driver; revolutions of follower = revolutions of driver x diameter of driver ÷ diameter of follower. Note.—The number of teeth may be taken instead of diameter of wheel.

To find the diameter of a driving wheel or following wheel

or disc.—Diameter of driver = revolutions per minute of follower x diameter of follower ÷ revolutions per minute of driver; diameter of follower = revolutions per minute of driver x diameter of driver ÷ revolutions per minute of follower.

To find the velocity ratio in a train of wheels.—Multiply together the number of teeth in each driving wheel, multiply together the number of teeth in each follower; the first product will be the number of revolutions the first driver makes, while the second product is equal to the number of revolutions the last follower makes in the same time.—From Rules and Definitions by Wallace Bently, A.I.Mech.E.

LONG BURNING ENCLOSED ARC LAMPS.*

BY WM. A. TURBAYNE, HAMILTON.

The major factor of expense coupled with the operation and maintenance of arc lamps arose from renewing the carbons, which, in the sizes adopted in practice, had a life of some seven or eight hours only. As the all-night lighting of streets demanded that lamps should be capable of giving an uninterrupted service of from twelve to fourteen hours' burning, various means were devised whereby this period could be covered by a single trimming of carbons. Innumerable types of lamps were designed with this end in view, but there remained to be adopted as standards the double carbon lamp, which burned two successive pairs of eight hour carbons and, as an alternative, the single carbon lamp fitted with circular or elliptical carbons of sufficient cross section to insure a life of fourteen or sixteen hours. Aside from the matter of trimming, however, the carbons themselves were a source of heavy expense, and early endeavors were made to perfect some means whereby their life could be materially prolonged without at the same time incurring a sacrifice of the light. It was clearly understood that the rapid wasting away of the carbons was caused mainly by their combustion in the open air, and it naturally occurred that if the arc could be maintained in a transparent chamber, from which the oxygen of the air had been excluded, that this combustion would cease and that then the only waste would be that due to vaporization. Experiments along these lines were conducted and the results would undoubtedly have been encouraging had it not been chiefly for the fact that, in burning in an enclosing chamber, such a deposit soon accumulated on its inner surface as to seriously obscure the light and thus render the arrangement unpractical and, therefore, as these attempts to increase carbon life proved futile, fourteen or sixteen hours per trim was, until very recently, accepted as the burning period of an arc lamp. The great demand within the last eight or ten years for interior arc lamps operating from incandescent lighting circuits was met by a marked improvement in carbon manufacture, until finally a practically pure article was obtainable, the advent of which made possible the maintenance of an arc in an enclosing chamber and allowed of the development of the long burning lamp as we have it to-day in which a carbon in size equal to the eight-hour carbons of open arc lamps has a life of one hundred and fifty hours or more.

This longevity is effected by preventing combustion by a removal of the oxygen from the space immediately surrounding the arc, the oxygen not being literally removed by exhaustion, but rather by a process of chemical conversion wrought by the action of the arc itself. The carbons are surrounded by a glass globe of small area, closed at the base and only sufficiently open at the top to allow of a free passage of the upper carbon. On the formation of an arc the air contained within this globe is heated and rarified, the surplus finding an outlet through the upper opening; the remaining oxygen is reduced by combustion with the carbon to carbon monoxide (C.O.), a gas which is somewhat lighter than air, having a specific gravity of .969, and although combustible will not support combustion. This, together with the nitrogen which is liberated, completely fills the chamber and prevents further combustion of the carbon, although a small amount of air diffuses through the upper opening—a condition essential to satisfactory operation, as otherwise the vaporized carbon would condense and appear as a sooty deposit on the inner surface of the globe, while as it is, the oxygen of the entering air unites with this vapor and forms a gas. A slight deposit of silicon accumulates, which, however, does not seriously absorb the light, and which may be readily wiped off during trimming.

As a result of the absence of oxygen in the enclosing globe the ends of the carbons do not become tapered by burning but remain flat and blunt, and the device could not be adapted successfully to the existing lamps in use, which maintain a potential difference of some 45 volts across the arc, as, in the small separation of one-eighth inch or under consequent upon this voltage, too much of the light would be intercepted by the lower carbon. It was therefore imperative, in order to obtain proper distribution, that the carbons be more widely separated, and it was found that in the enclosure an arc of approximately ⅜-inch in length could be maintained with an E.M.F. of some 75 or 80 volts. Meanwhile it is necessary that the current employed should not exceed 6½ or 7 amperes, for obvious reasons associated with the cleanly burning of these lamps for long periods, and in order further that the watts expended may correspond with those expended in an open arc lamp of like rating. While a so-called 2,000 c.p. lamp of the latter type operates with a current of 10 amperes at an E.M.F. of 45 volts or 450 watts, an enclosed lamp of like rating may operate at 6.5 amperes and 70 volts, or at 5.5 amperes and 82 volts, the higher E.M.F. and reduced current resulting within certain limits in better operation. Enclosed arc lamps in general require special features in the feed mechanism, although the governing principles are identical with those obtaining in the open lamps. As it is necessary to separate the carbons from ⅜ or ½ inch it is usual to have the magnets act directly on the upper carbon without the intervention of levers, and this calls for a long range magnet of considerable power. In order also to obtain good regulation it is desirable that the moving armature be of considerable weight, as compared with the weight of the carbon to be lifted, as therefore decrease in weight of the carbon is not accompanied by an appreciable lengthening of the arc. Enclosed lamps will operate efficiently in series on direct constant current circuits employing currents not greater than 6.8 amperes, and on alternating current circuits in conjunction with constant current transformers. In these instances the lamps must be of the differential or shunt feed type, and must be further provided with short-circuiting cut-outs such as are found in the well-known open series lamps. A similar type of lamp is required for operating in series multiple on street railway and power circuits, but in place of the short-circuiting cut-out a device for shunting a resistance, equalling that of the arc, across the terminals is used in order that if one or more lamps cut-out or proved defective the current traversing the remainder would not rise. It is necessary also that a steadying resistance be placed in series with each group of such lamps.

Enclosed lamps for operating in parallel on direct and alternating current incandescent lighting circuits require a very simple feed mechanism and contain neither shunt magnets nor cut-outs. For adjusting the carbon a single magnet only is required connected in series with the arc. Such a magnet responds to variations in the current strength and tends to maintain this factor constant irrespective of variation in terminal voltage, but as this latter is a constant factor the magnet therefore in keeping the current factor constant must likewise keep the arc resistance and length constant also. A retarding device such as a dash pot is required in these lamps to allow of a gradual separation of the carbons, alternating lamps especially demanding a comparatively slow separation. As direct current lamps usually operate on circuits of 110 volts it is necessary to interpose a resistance in order to reduce this to about 80 volts as required across the arc, and, while this resistance wastes energy, yet it is necessary to the successful operation of the lamps. The alternating lamps are more fortunate in this respect inasmuch as a reactance coil may be placed in series with the arc which will reduce the voltage to that required across the arc with but little waste of energy. They may also be operated direct from transformers delivering the necessary arc voltage, or from economy coils, or auto-converters.

A type of lamp which represents simplicity in the extreme is that in which the separation and feeding of the carbon is effected by the expansion and contraction of a strip of metal interposed in the path of the current. Such a device, while not satisfactory when used in conjunction with open arc lamps, appears to be excellently adapted to parallel burning enclosed lamps, in which the arc is protected from draughts of air, and which feeds only

*From a paper read before the Canadian Electrical Association.

at long intervals. For this particular purpose, as compared with electro-magnetic feeds, the advantages all appear to be with the thermal feed. Such lamps strike their arc quietly and slowly without being necessarily retarded in their action by dashpots, their feed is positive, and slight frictions in the moving parts introduce no noticeable error; they may be operated at will on direct currents, or on alternating currents of either of the standard frequencies. On alternating currents the power factor of a load of these lamps would be high as compared with a load of lamps having large magnet coils and cores, and in the matter of maintenance there appears to be nothing about such a lamp to suggest repairs, although the replacing of an occasional regulating strip would be much cheaper than the renewing of magnets.

Aside from the economies of enclosed lamps resulting from the increased life of the carbons they possess other advantages peculiar to themselves. As a result of the absolute enclosure they burn quietly, being free from hissing or flaming even though not accurately adjusted, and, as it is impossible for sparks to make their exit, all possible fire risk is eliminated, a feature which meets with the unanimous endorsation of the boards of Fire Underwriters generally. By virtue of the long arc which is maintained more perfect distribution of the light over large areas is obtained than is possible with open arc lamps Direct current lamps of the latter type exert their greatest illuminating effect at an angle of about 45 degrees from the vertical so that a very intense light is noticeable within a radius slightly exceeding the height of the lamps from the ground, while beyond this the illumination rapidly falls away. Enclosed lamps on the other hand spread their rays more horizontally, their angle of maximum intensity being about 75 degrees, and as a result the light is more regularly diffused over a large area and does not assume the form of concentric zones of rapidly diminishing intensity. The economy in maintenance however, affords the most striking example of the advantages of enclosed lamps over the open and the gain will be clearly noted by a comparison of the two systems. As an example we may compare the maintenance costs of 450 watt open and enclosed alternating current lamps operating 10 hours per day per year of 365 days, assuming for the former a life of 14 hours per trim of carbons costing $36 per 1,000, while for the latter a life of 80 hours per trim of carbons costing $30 per 1,000. In this comparison the matter of interest and depreciation allowance may be dismissed on the assumption that it will be similar in each case and thus there remains to be calculated the cost of carbons and trimming.

As the open lamp requires two new carbons per trim it will in a year therefore, on the above basis of 10-hour runs per day, require some 261 pairs of carbons, costing $18.80; on the other hand the enclosed lamp requires but one new carbon per trim and in a year will consume but 46 carbons, costing $1.38, so that an annual saving of $17.42 per lamp is effected by the use of the enclosed lamps. The cost of trimming will depend largely upon local conditions, but we may assume that one man at $2 per day can trim one hundred open lamps, or one-half as many enclosed lamps, which will make the cost per trim, therefore, 2 cents and 4 cents respectively. On the 10-hour basis the trimming, therefore, will cost approximately $5.62 per open lamp per year, as against $1.84 per enclosed lamp per year, resulting in a further annual saving in favor of the enclosed lamp of $3.78, making the total saving $21.17. With direct current lamps the saving will be in like ratio, allowances for differences in the life and cost of carbons being necessarily taken into consideration, but whether direct or alternating the advantages of the enclosed lamp are so apparent that before a great period elapses not only will they largely supplant the open arcs, but they will further enter the arena in competition with large incandescent lamps and regenerative gas lamps.

STEAM POWER FOR AUTOMOBILES.

For some years Sir David Salomons and other experimenters and engineers in Britain have been vaunting the praises of steam as a motive power for autocars, arguing for it as the ideal power on account of its expansiveness or range, and hence being superior to the gasolene engines whose limits are but too well known, and resembling electricity minus the difficulty of recharging batteries. The Serpollet boiler gave Sir David and his friend good ground for argument, and as a matter of fact steam is being pushed to the front in Britain, especially for heavy traction. The Americans have done much better with steam automobiles than either British or French inventors—the latter having given chief attention to gasolene, or "upetrol," as it is called. Some rather sudden and surprising developments in steam autocars have been made in New England. It is to be noted that the Western and Middle States of the Union have as yet produced no steam autocar. The reason stated by experts is that nowhere in the United States except in New England can the extremely fine work be had that is required in steam vehicles. Every engineer will understand that a 4-wheel two-passenger carriage, whose total weight empty does not exceed 400 lbs., the boiler shell being only 14 inches diameter by 13 inches high, and yet containing 306 tubes, requires exact adjustment and minute mechanism that would drive the ordinary machine shop foreman crazy. Yet the Stanley brothers had no difficulty in getting such work done in a rush, so that their first carriage was completed within six months. New England now boasts three prominent steam carriage makers—Whitney of East Boston, Stanley Brothers, the famous dry-plate makers of Newton, Mass., and the Overman Wheel Co. of Chicopee Falls, Mass.

At the motor vehicle contest in Boston in November last, the performance of the steam carriages astonished the crowd of 2,000 persons, for steam power done up in such compact form was decidedly novel. On a 3-lap cycle track the Whitney wagon, weighing 1,000 lbs., made a 2-mile run in 5.40 2-5, while the Stanley wagon, weighing 400 lbs., finished the mile in 2.11. Whitney says he has often made a straight-away mile inside of 2 minutes.

The hill climbing contest gave the hardest test. A plank track 85 feet long was laid level for the first 10 feet, and the balance in sections of 10 feet, each section raised 5 degrees higher than the preceding, the final angle being 35 degrees. This made a constantly increasing up-hill angle of track, which is

Stanley Steam Carriage.

vastly difficult. Some seemingly powerful cycle riders tried it with a flying start, but could not go much above half way up Whitney with 125 lbs. of steam ran up the grade beyond his brake control, and had to be caught by men standing on the incline, and steadied down to where his carriage could take care of itself Stanley took the hill, running up to the top, and bumping the cross bar at the end, from a standing start at the bottom of the incline, no headway run on the level being made. Stanley had probably 150 lbs. boiler pressure for this hill effort It looked as though Stanley was going to come down with a rush, but after some hurried scrambling the wagon was seen to be under control. The Stanley engines were not made to reverse, but the reversing feature has been added since this test.

The following particulars in regard to the power and gear of the Stanley steam wagon, given by Hugh Dolmar in The Cycle Age, will be of interest to steam engineers: "Boiler shell

copper, 14 inch diameter by 13 inch high; No. 20 B. & S. sheet metal gauge in thickness; 300 tubes, copper, ½-inch diameter, 13 inches long, No. 20 B. & S.; fuel, gasolene; cylinders, a pair of simple engines, 2¹⁄₄-inch bore by 3¹⁄₄-inch stroke, plain eccentric valve motion, plain slide valves, no link, fixed cut-off at about 9 to stroke. The speed reduction from the engine shaft to the compensating gear box is 2.2 to 7.12 tooth sprocket on engine shaft, and Baldwin separable chain to a 33 tooth sprocket on the gear box. Driving wheels, 28 inch diameter, with suspension, laminated wood rims and 2-inch Hartford single tube tires. Running a mile in 2.11, the engines made 720 by 2¹⁄₂, or 1,800 revolutions, and the number of exhaust was 7,200. The engines made a little under 837 turns per minute. The boiler pressure was probably about 140 lbs., and as all the connections are very direct and short, it seems that the mean effective pressure on the pistons should be little short of 80 lbs. However, the combined piston area is 9.8 square inches, and the piston travel was 487 feet per minute, going something like 11 h.p. nominal. This seems incredible for a boiler of the dimensions given, and it seems therefore probable that the mean effective pressure must have been below the 80 lbs. assumed."

In speaking of the conduct of the Stanley wagon during the exhibition mile run, Mr. Dolnar states that there was a perfect absence of odor, ease and celerity of movement, and almost total silence. At Stanley's top speed the connecting rods and cranks were invisible, and the noise of the exhaust was an agreeable hum, almost a musical note, there being 3,348 puffs per minute. The exhaust steam spread out in a thin gray veil, and extended about six feet in rear of the wagon. Stanley and Whitney had practically the same boiler, and the only practical difference between them was that Stanley had a perfect burner under his boiler, while Whitney's was by no means so good.

The Victor Automobile—the name of the steam carriage just put on the market by the Overman Wheel Company—is introduced as marking a new era in the use of steam, "pre-eminently the power to use on automobiles," The makers claim they "have solved the problems which heretofore prevented the use of steam in the hands of the general public. With a Victor Automobile," they say, "it is possible to go for 25 miles and do absolutely nothing except to put the power on by opening the throttle and to steer." The height of water in the boiler and the pressure on the fuel tank are maintained automatically, and guaranteed not to vary beyond an inch of water or a pound of pressure. The wagon to seat two persons has 4 h.p., and is geared according to the hill-climbing or speeding necessities of the purchaser.

A curious feature of the development of the steam carriage in the United States is that the Stanley Brothers are neither of them engineers, and neither of them is to-day familiar with the ordinary details of steam engine construction; yet they have produced what Mr. Dolnar—an engineer of forty years' experience—regards as the closest approach to a practicable mechanically-propelled road wagon yet shown. They are men of unique personality, accepting nothing as authoritative, except the result of their own independent investigation and researches, and are utterly scornful of all practice and precedent. Whitney had built steam wagons before them, but they did not adopt Whitney's boiler construction, but originated an entirely new form of boiler shell, which makes the tube expansion and shell expansion always the same, and hence makes such a thing as a leaky tube unknown in their boilers. They also originated a gasolene burner for firing this boiler, which uses no forced draught or air pressure, and produces a silent fire without any of that roaring which had hitherto marked all oil-burning steam generators of rapid action.

There is just one bit of data that is lacking in the various accounts of the exploits of steam wagons which we have read, that is, the clogging of the tubes with lime deposit. If "scale" proves such a detriment to ordinary steam boilers, what may be expected of a multitude of minute tubes when limestone water is taken from the wayside pump, or dipped from the side-road ditch? How long would a traveler be safe from explosion if his runs should be made in a locality such as Guelph or Limehouse?

Horseless Vehicle Parade at Columbia College, New York.

THE PROPER EFFICIENCY OF INCANDESCENT LAMPS FOR CENTRAL STATIONS, INCLUDING A DESCRIPTION OF THE NERNST LAMP.*

BY E. E. CARY, ST. CATHARINES.

Few questions in the field of electric lighting are of greater importance to central station managers than that of the efficiency of incandescent lamps, and few questions seem so thoroughly misunderstood, and yet the fault is not entirely with the central station. In the first place, only the larger companies will invest in the necessary apparatus, and surprisingly few of these will purchase enough apparatus to determine the efficiency of their lamps. The initial outlay, including photometers and instruments, will more than pay for itself in the first year. In the absence of the proper outfit, the managers have to depend upon the statements of manufacturers or more often upon those of their representatives, and what is the result? Dissatisfaction. One maker will supply lamps guaranteeing them to be of a stated efficiency, and these lamps will give satisfaction. Should the next order be placed with another company and the same efficiency guaranteed, chances are strongly in favor of the second consignment not giving satisfaction, assuming the specifications call for efficient lamps. Both lots of lamps may consume the same current at the stated voltage and in reality be intrinsically equal, yet one will be thought well of and the other condemned. A situation such as this, upon the face of it, seems incredible, yet such is the daily experience of every lamp manufacturer until by long and often costly experience he becomes thoroughly acquainted with the actual state of affairs upon the lines of all his customers.

For many years generators, and later transformers, have been rated in light capacity upon the basis of fifty watt lamps. It has been unfortunate that 3.1 watt lamps have become such a household term, as their use has often proven very costly to companies before experience made them alter first ideas. Everyone will probably agree that it is desirable to use the most efficient lamps possible, consistent with fair life where current

*A Paper read before the Canadian Electrical Association.

is supplied upon the meter basis. Two questions immediately arise; what should be considered fair life, and at what efficiency under conditions existing upon the lines can this life be most economically obtained. Every lamp maker, however worthy of the name, has on record the results of many tests showing the average life to be expected of lamps of different efficiencies when operated at normal or at voltages other than normal. Below in table 1 will be found the efficiency and average life of lamps at various voltages. Though these results are in one sense approximate only, yet they are the average results of many tests. Before discussing the table, it is well to state that the efficiency of an incandescent lamp is generally given in watts per candle. A lamp radiating sixteen candles when operating at fifty volts, and one ampere of current, consumes fifty watts, and has therefore an efficiency of 3.1 watt per candle. When lamps are tested for efficiency, one grievous error is generally made. The voltage is taken carefully as labelled on the lamp instead of being taken at the point of the lines where the lamp will be used. For example any lamp, whatever its normal efficiency may be, can, and often is operated at a much higher efficiency. For instance a four watt lamp is often burned at three watts, and a three and a half watt often burns at two and a half watts. This is simply to show that when a manager talks of using more efficient lamps, he may be operating at that very time, lamps at a higher efficiency than he contemplates using.

If a station is using 3.5 watt lamps and had absolutely steady voltage, an average life of 900 hours could be expected. If the voltage, however, is 2 per cent. high, this life is reduced to 700 hours, and the efficiency increased to 3.27 watts. If, however, the voltage is 4 per cent. high the life is reduced to 550 hours, and the efficiency increased to 3.05 watts. Though the candle power is increased, the total watts consumed is not proportional and the station suffers doubly in consequence. Four per cent. increase in voltage of a sixteen candle power lamp increases the light emitted about 20 per cent. This table will probably impress on central station managers how vitally important it is to know the voltage at which their lamps are operating upon different portions of their lines. Unless the regulation throughout the system is unusually uniform, it is most profitable to have the entire system divided into sections or zones, and order lamps of different efficiencies adapted to give the life settled upon as desirable. If the fluctuations are comparatively the same in the different zones, then the same efficiency can be used, only the lamps should vary in voltage, the voltage to be used to be the same in each zone. The manager immediately states that this causes too much confusion, etc., yet it is good business, and is a no more confusing problem than many others in manufacturing. When a method like this is carried out, very black lamps would disappear, average life be greatly increased and customers would be much better pleased. Take a customer upon your lines where the voltage is 4 to 6 per cent. high, not to speak of 20 per cent. as is often found, and when you replace burned out lamps what is the result; the new lamps may emit from twenty to thirty-two candles and the old lamps eight to ten. Naturally the customer complains that the old lamps are worthless, and to keep peace, you replace these also and he starts with practically all new lamps, the same trouble to be gone through with later on. In the meantime you are apt to write the manufacturer that his lamps are blackening badly and return these specimens as fair samples. Troubles arising from cause similar to this have forced manufacturers oftentimes, who cannot or will not investigate the trouble, to send out their lamps uniformly of a higher voltage than is marked on the labels. This is one sense self protection, which the manufacturer is forced to do if he wishes to retain the trade which is often at such a distance that he cannot afford to investigate personally.

Most lamps imported from the United States to-day are much higher in voltage than indicated on the label. Yet the central station, if it has not due regard for the light emitted, will be pleased with the lamps, as they may last almost indefinitely. The most welcome information a manufacturer can receive is to the effect that a central station does not wish a lamp to last forever, so to speak. Consider for a moment how small the expense of the renewal item is under normal conditions. Assuming only 600 hours average life at the low average meter rate, 6-10 cents per lamp hour, the income is 3.60. Good lamps can be purchased for 20c. each or less than 6 per cent. of the income. When lights are furnished upon the flat rate basis, and the renewals are paid for by the consumer, highly efficient lamps are not desirable.

When central stations will determine intelligently the proper efficiencies of lamps which they should use, and take means to hold manufacturers to their specifications, then their lamp renewal account will considerably decrease and the legitimate lamp maker prosper proportionately. Below is given another table of current in amperes taken by lamps at various voltages and candle powers at different efficiencies, which may be found useful for reference:

EFFICIENCY AND AVERAGE LIFE OF LAMPS AT VARIOUS VOLTAGES.

Efficiency in Watts per C.P. at Normal Voltage.	Average Life at Constant E.M.F.	98 per cent. of Normal Voltage.		99 per cent. of Normal Voltage.		100 per cent. of Normal Voltage.		101 per cent. of Normal Voltage.		102 per cent. of Normal Voltage.		103 per cent. of Normal Voltage.		104 per cent. of Normal Voltage.		105 per cent. of Normal Voltage.		106 per cent. of Normal Voltage.	
		Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.
4.5	2400	4.85	3500	4.68	2900	4.5	2400	4.34	2060	4.21	1830	4.06	1600	3 92	1400	3.8	1240	3.7	1120
4.	1500	4.31	2000	4 16	1750	4.	1500	3.86	1330	3.74	1160	3 62	1020	3 48	880	3.38	800	3 28	710
3.5	900	3.77	1200	3 64	1040	3 5	900	3 38	800	3.27	700	3 16	620	3.05	550	2.96	490	2 87	440
3.1	580	3.34	760	3.22	660	3.1	580	2.99	500	2.9	460	2.8	400	2.7	360	2 62	320	2 54	280
2.5	260	2 69	350	2 6	310	2.5	260	2.41	230	2.34	210	2.26	190	2.18	170	2 11	150	2 05	140

CURRENT IN AMPERES TAKEN BY LAMPS IN VARIOUS VOLTAGES AND CANDLE POWERS.

3.1 Watts per Candle.

Candle power.	50 volts.	55 volts.	80 volts.	95 volts.	100 volts.	105 volts.	110 volts.	120 volts.	220 volts.
8	.50	.45	.31	.26	.25	.24	.23	.21	.11
16	1.0	.90	.62	.52	.50	.47	.45	.41	.23
25	1.6	1.4	.97	.82	.78	.74	.70	.65	.35
32	2.0	1.8	1.3	1.1	.99	.94	.90	.83	.45
50	3.1	2.8	2.0	1.7	1.6	1.5	1.4	1.3	.71

3.5 Watts per Candle.

Candle power.	50 volts.	55 volts.	80 volts.	95 volts.	100 volts.	105 volts.	110 volts.	120 volts.	220 volts.
8	.56	.51	.35	.30	.28	.27	.26	.23	.13
16	1.1	1.0	.70	.59	.56	.54	.51	.47	.26
25	1.8	1.6	1.1	.92	.88	.84	.80	.73	.35
32	2.3	2.0	1.4	1.2	1.4	1.1	1.0	.94	51
50	3.5	3.2	2.2	1.9	1.8	1.7	1.6	1.5	.80

4 Watts per Candle.

Candle power.	50 volts.	55 volts.	80 volts.	95 volts.	100 volts.	105 volts.	110 volts.	120 volts.	220 volts.
8	.64	.58	.40	.34	.32	.31	.20	.27	.15
16	1.3	1.2	.80	.68	.64	.61	.58	.54	.29
25	2.0	1.8	1.3	1.1	1.0	.95	.91	.84	.45
32	2.6	2.3	1.6	1.4	1.3	1.3	1.2	1.1	.58
50	4.0	3.7	2.5	2.1	2.0	1.9	1.8	1.7	.91

Before describing the Nernst lamp I will say in reference to 220 volt lamps that great progress has been made in their manfacture during the past year or two, but that little further is necessary in making them more efficient before they will be on a par with 110 volt lamps. In addition to this, plants must be installed calling for a range of 220 to 240 volts before the cost of the lamps can be brought to its proper level by the manufacturer.

During the past year vague rumors have occasionally been

wafted across the water of the discovery of a new light, although details of the discovery were entirely lacking until Mr. Swinburne delivered his now famous lecture before the Society of Arts in London, February 8th. I will quote from this lecture a few descriptive remarks and then give some criticisms of the lamp from other sources. Mr. Swinburne in speaking of Nernst's discovery says: "Nernst's, like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature. Nernst therefore chose a material that would stand higher temperature than carbon, and his material has the incidental advantage, that its specific resistance is so high, that strong rods can be used for high pressure instead of thin filaments. Nernst takes highly refractory oxides as his material. It does not seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot; Nernst therefore, heats the rod to make them conduct, and then heats them electrically, preserving a temperature which is within the limits that the material can bear without softening. * * * The material is worked up into little white rods. Each rod is mounted on two platinum wires, a little paste made of refractory oxides being applied to the joints. The little rod with its two wires, is then mounted in holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electrolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp which has analogous properties due to a different cause by a series resistance. The Nernst rod has therefore a resistance in series. This is made up of exceedingly fine wire, and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistance of the lamp. The consumption, including the resistance is 1.5 watts per candle for large lamps, and 1.6 for small lights of low pressures. In small or low pressure lamps the loss of heat at the ends is larger in proportion. Such a lamp as I have described will not light up of itself, for the rod is an insulator when cold. The simplest way to start it is to warm it with a match, or better with a small spirit lamp. Such a lamp as this is not only very cheap as regards first cost, but economical in running. The life of rods, running at an efficiency of two-thirds of a candle per watt, including the resistance, is already more than 500 hours in good specimens. If the Nernst lamp advances as much in the first years of its existence as the carbon lamp did between 1880 and 1882, it will soon be made so well that the rods will last a lifetime. When the rod is worn out, a new rod with its little mounts is all that is replaced. The whole lamp is not thrown away at all. The small lamps and the lamps of medium size are in practice started by a heating resistance. This is arranged close to the rod, and in shunt to it. As soon as the rod is hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the heating system is a little more elaborate, as the resistance arrangement is arranged as a sort of hood which covers the rod. As soon as the rod conducts, not only is the resistance circuit broken, but the electro-magnet lifts the little hood clear off the rod. In all these forms, the rod and its mounting are replaceable without interfering with the rest of the lamp."

The above extracts give a very clear idea of the Nernst lamp, as first described to the public by those interested in promoting a large company for its exploitation. There are however serious practical difficulties involved in the practical operation of these lamps at the present time. Assuming however for the sake of argument that the Nernst lamps can be operated successfully in practice, the relative cost of this operation compared to arc and incandescent lamps is what chiefly interests the central station manager. The English Electrical Review recently published an article by John I. Hall upon "The Nernst Lamp vs. The Arc and Incandescence Lamps." I quote for your information a part of this article, giving comparisons in cost between the Nernst and arc lamps. These are the only figures that have been recently published. After speaking of various methods of lighting, Mr. Hall writes: "But at present the position of the various illuminants may be summed up as follows. 1. The Welsbach system is an advance over the ordinary method of lighting by gas 2. The enclosed arc lamp is an advance over the open arc. 3. The Nernst system is an advance in incandescent lighting. The electric lamps are placed in the order they will occupy in regard to cost of maintenance, for as the Nernst lamp supersedes the enclosed carbon lamp, so does the arc lamp supersede the Nernst lamp." J. Swinburne, in the prospectus of the Nernst Electric Light, Limited, states that: "It will, I believe, oust the arc lamp in nearly all cases." On examination it will be found that it will not oust one arc lamp at present in use, as the following particulars will show:

The Nernst lamp is said to give 1 c.p. for an expenditure of 1.5 watts. The arc lamp (2,000 n.c.p.) absorbs 500 watts and actually gives 1,200 c.p. The Nernst lamp to give 1,200 c.p., will require an expenditure of 1,800 watts, or 3.6 times more energy than the arc lamp; 1,800 watts = 1.2 kilowatts per hour, which will cost to the consumer 3.6d. per k.w. per hour. The arc lamp absorbs 0.5 k.w. per hour, and this at 3d. per unit equals 1.5d. These figures are for public lighting; for private consumers the cost is, of course, increased. Allow a liberal amount for carbons, trimming and cleaning, etc., say, 0.5d. per hour, then there is 1.5 + 0.5 = 2d. per hour as the cost of the arc lamp against 3.6d. as the cost of the Nernst lamp. The figures given above are for the open arc lamp, but for the enclosed arc lamp the cost would be about 1.6d. against 3.6d. for the Nernst lamp. In other words, instead of our corporations running their street arc lamps for, say £18 per annum per lamp, they will, by adopting the Nernst lamp, run them at £64, or spend £46 more per lamp.

It will therefore be considerable time before the municipal electrical engineer is found who will be ready and willing to come forward and suggest the ousting of the arc by the Nernst lamp. The Nernst Electric Light, Limited, prospectus further states that "there is no difficulty in running in parallel on 1,000-volt circuits without transformers." It will be of some interest to the electric light engineers to find the 1,000-volt circuits without transformers amongst the electric lighting stations. However, the merits of the 1,000-volt lamps can be considered as against the arc lamps. Suppose the advantages of the Nernst lamps are considered running in parallel on 1,000-volt mains. Is there any economy in conductors to be secured under these circumstances? Take a section of, say, 20 arc lamps, with transformers, running in parallel and controlled from a substation. The current required will be

$$\frac{20 \times 500 \text{ watts}}{2{,}000 \text{ volts}} = 5 \text{ amperes primary current.}$$

For 20 Nernst lamps the current will be

$$\frac{20 \times 1{,}800}{1{,}000} = 36 \text{ amperes primary current.}$$

Thus it will be seen that, taking the most favorable conditions set down by the prospectus of the company for the Nernst lamp to compete with the arc lamp, a cable of seven (7) times the sectional area will be required, in addition to the transformer, for them to run on existing installations where the E.M.F. is 2,000 volts. The cost of the lamp cases and posts now remains to be considered. It may be taken that the lamp-posts will cost about the same in both cases. The arc lamp complete, with hood and globe, costs, say, £6, and the Nernst lamp £1. This appears to be a fair price, allowing for promotion anticipations without actual figures as to cost. The first cost, and maintenance for 12 months, may now be considered, voltage 2,000 lamps in parallel:

Arc lamp and transformer, say	£12
Say cost of cables	3
Maintenance for twelve months	18
Total cost	£33
Nernst lamp and part cost of transformer situate in sub-chamber (voltage 2,000 to 1,000)	£ 3
Cost of cables	21
Maintenance for twelve months	64
Total cost	£88

There are other considerations of cost, such as conduits, depreciation and interest on capital outlay, which the electrical engineer will observe are not in favor of the Nernst lamp, and so they are, in kindness, omitted. To summarize the foregoing

particulars, it is pretty plainly to be seen that the rosy and light-hearted view taken by the Nernst Company as to ousting the arc lamp will need some slight modification, especially on the score of first cost and economy. Unfortunately for the newcomer there are such things as cables to be taken into account and maintenance.

So, then, the manufacturers of open and enclosed arc lamps are not yet to put up the shutters, stop the machinery, and discharge the workmen; but it is not so pleasant an outlook to the carbon lamp manufacturer unless he commences to make the Nernst type of lamp (under license, of course) or improve the carbon lamp, as will appear later on. But there are other considerations to be taken into account where the advent of the Nernst lamp will be most beneficial, and where it will be appreciated, as we shall have for street lighting two illuminants to choose from, and where one is not applicable the other will be most serviceable. It may be considered that for lighting large areas such as squares, public markets, etc., and main streets and roads, the arc lamp will not be superseded, but for the lighting of narrow streets, public halls, etc., the Nernst lamp will be a most valuable acquisition, on account of the increased economy in running. In all the circumstances it must be considered that the lamp is automatic in its action, as the match-assisted lamp is out of question in 1899, excepting, of course, to the promoters. The engineer and manager of one of the most successful gas works in the country said to me, when discussing the merits of the Nernst lamp: "Why, you will be going back to the old barbarous times of gas lighting if you use a match to light your incandescent lamp, and all the advantages of the enclosed filament lamp will be dispensed with."

TRANSFORMER ECONOMY.*

F. H. LEONARD, JR., MONTREAL.

(Continued from last issue).

Central station practice has not yet settled down to uniform methods of installation, but the trend now seems to be in the direction of larger transformers with secondary networks preferably on the thin wire system. The general introduction of meter basis of charge, making it possible to safely connect double the rated transformer capacity in lamps to the secondary network—whereas with the older systems, providing a separate transformer for each connection, it was necessary to provide transformer capacity equal to the lamps connected. With separate transformers of small sizes, necessary for individual supply, the aggregate core losses become a serious drain upon the central station. We have frequently seen banks of small transformers serving a single customer or group of customers, this condition being brought about by the gradual growth of demand for light exceeding the capacity of the original transformer installed, a further growth exceeding the capacity of the second, and so on. In such cases the substitution of a single large transformer of modern design, displacing the small ones, would save its price in less than a year, if credited at the usual selling price, with the amount of current saved. Don't put a modern transformer of good regulation into a group of antiquated transformers of poor regulation; if you do you will lose your new transformer, which is likely to be unjustly condemned for trying to improve the regulation of its bad associates. Placed in such company, the new transformer tries to maintain the good regulation for which it was designed, while the lazy, old slurks, with which it is connected, steeped in the vice of bad regulation, throw their entire load on to the new comer, which good naturedly carries it all till it can no longer stand the strain, and literally roasts out and breaks down under the load.

In most of the smaller stations, and in many of the larger ones, money can be saved by remodeling the system of distribution, and at the same time improving the service by laying out a net work of secondary mains, starting first in the business portion of the town, with the installation of a few large transformers, reserving the small transformers, which these replace if they are modern and worth keeping—for extensions in the more remote sections, where for the time the secondary network is impractical. It may occur in some cases the secondary network will be practical in several different sections, and these separate sections will, in most cases, gradually grow together, allowing taps to be made for new customers at intermediate points. In most cases, where prices are based on meter rates, such an arrangement can be installed at no greater first cost than the individual transformer system—the saving in cost of transformers, on account of their larger size and less total capacity required, paying for the copper mains. Such an arrangement always results in more satisfactory service to the consumers, at the same time greatly reducing the leakage current necessary to magnetize the transformers or supply the waste in core losses.

A few figures may serve to impress the idea more firmly in your minds. Let us take the case of a station having an average load, equivalent to 1,000 lights, most of which average four hours burning per night, and making due allowance for belting, dynamo, line, transformer and secondary wiring losses, we will allow that 10 lights are obtained per 1 h.p. at full load. In the first case we will suppose an individual transformer system is installed, using 10 10-light, 10 20-light, 10 30-light, 5 40-light, and 4 50-light transformers, even with modern transformers these would have an aggregate core loss of about 1,200 watts. If we substitute for this arrangement 6 150-light transformers, connected with a secondary main, retaining the 10 small transformers for isolated customers so scattered as to make it impractical to connect them to the secondary mains, our core losses will be reduced to 692 watts, or a saving of 448 watts for every hour the plant is run, which for twenty-four hours a day would amount to 3,920 k.w. hours per year, which at 10 cents per k.w. hour would be $392, or 6 per cent. on more than $6,500, a sufficient amount to more than pay for the change, if no consideration is made of the transformers left on hand, which would be superseded by the new arrangement. In the case just mentioned, we have assumed the original arrangement to be modern transformers. Had we assumed them to be old types, the saving would have been three or four times that shown, and would have allowed us to make a good or a better showing had we only charged 3c. per k.w. hour, which would be less than the cost of production in a station of 1,000 lights capacity. Some of our friends may argue that these losses cost them nothing, as they are running on water power, but we would like to remind them that the capacity in their generators, water wheels, or whatever prime movers they use, represent capital invested which add to the fixed charges their pro rata of interest and depreciation for which it makes no return, whereas, if the capacity used in overcoming these losses could be rented at the usual rates, a material difference in the capacity to pay dividends would be shown.

*Paper read before the Canadian Electrical Association.

CENTRAL STATION ACCOUNTING FROM A BUSINESS STANDPOINT.*

BY P. H. HART, MONTREAL.

The reasons why a standard system of accounting for central stations ought to be adopted are many and substantial. The individual owner of a small plant is as much interested in having accurate knowledge of the condition and details of his business and a determinate method of obtaining such condition and details, as the manager or directors of a large joint stock company. A proper system of accounting should show to the directors, manager, proprietor or other interested party (and for the sake of brevity I will hereafter refer to such parties as manager) besides the profits or losses of the business, the cost of producing what is sold, and should demonstrate this cost in such manner as to enable him to learn what the product costs in its various details, and particularly the costs separately of generation and distribution. These being determined and ascertained in the ordinary progress of business and due account being had of interest on investment and depreciation of plant, the manager can compare costs and determine where excesses arise, whether in the generation or distribution, and the reasons therefor. It should also show promptly and definitely the condition of affairs of a business at any and for given periods, which is a decided requisite and absolutely essential to sound business administration. It should be such as to enable the manager to determine the advisability of soliciting or catering for any particular line of business that may be offered or obtainable and

*A paper read before the Canadian Electrical Association.

indicate the most profitable, and be a guide, preventing indiscriminate investment in pole line construction, apparatus, etc., and show at all times the value of the investment for such purposes as insurance, arbitration, assessment, etc., etc. With such information created, compiled and formulated in the regular progress of the business, the manager will be enabled to consider intelligently operating costs and the advantages or disadvantages of further investment. I may here call your attention to some interesting information which appears in the 14th annual report of the Board of Gas and Electric Light Commissioners of Massachusetts, Public Document No. 35. This shows that out of 58 electric light companies operating in that State, with a total investment of over $17,000,000, five of the companies appear not to have earned expenses, and 32 have not earned sufficient to warrant the declaration of any dividend: thus very near 10 per cent. of the electric light companies operating in that State do not earn expenses, and 37-58, 63 per cent., are not earning sufficient to make a return to the investors on their capital. Many of them, no doubt, may have believed they were doing well until a rigid system of accounting had been applied. These commissioners are doing much to standardize the system of accounting in use by electric lighting companies in that State, and this statistical information is the direct result of a uniform method adopted by these commissioners in adjusting the statements submitted by the various companies. H. A. Foster, who investigated in detail 160 electric lighting stations of the United States, for the United States census, in a work based on the information gathered by him in the taking of this census and recently published, entitled "Central Station Bookkeeping," regrets the lack of system in accounting shown by the various electric lighting stations which came under his notice, and lays particular stress on the necessity of accurate accounting in central station work, for obvious reasons.

In addition to other reasons for and the advantages of a standard system of central station accounting, I might say that in the event of the question of municipal ownership or purchase arising the manager should have definite knowledge as to the cost of investment, cost of operating, etc., to compare with assumed cost of municipal operation. I will now present to you a system of accounting at present in use, having the objects above outlined in view, the results of which have been highly satisfactory, and in connection with it a system of records which form necessarily a part of a thorough accounting system. In the presentation I will indicate some of the various books and forms in use. Central station accounting from a business standpoint should proceed from and be based upon an order system, guiding, directing and allotting in advance the distribution of expenditure for investment, operation or maintenance and of revenue to the several distributions or sub-divisions of those general items that may be deemed desirable. And here I may say that such sub-divisions should be as numerous as the several details of a business, and when arranged for and determined upon beforehand, becomes, in practice, very easy of allotment or apportionment. A written order should be issued covering each and every transaction, indicating the character of the transaction and the accounting to which the expenditure incurred therefor is to be charged, or the revenue derived therefrom is to be credited. This to be determined and declared in the order before the expenditure is made or the revenue derived. Such system necessarily means that for every debiting entry to an account, something must be credited and all entries and accounts must result in a perfect balance, so that double entry bookkeeping is absolutely necessary to the practical working and comprehension of this system. The system referred to herein, and partially illustrated by various forms or blanks, can be readily put into operation by any company and practically at any time desired. Under the system described as at present carried out, the accounting is eventually grouped into what may be designated as general accounts, which are kept in a general ledger. All the other accounts, subordinate to these general accounts, and forming what may be designated as the working accounts, and which lead up to and are finally grouped into general accounts, are kept in other or subsidiary ledgers. This subdivision of books or ledgers is done in this instance simply as a matter of convenience, because the volume of business is large and necessarily requires to be attended to by a number of persons; but the principle involved would permit carrying all the accounts in one set of books if the volume of business were so small as to make that desirable. The general accounts consist of the assets and liabilities, and may be sub-divided in accordance with the wishes of the manager—as, for instance, the asset account of merchandise might, if desired, be sub-divided into fuel, line supplies, station supplies or wiring supplies, etc., such accounts representing materials on hand for use as required, either for any addition to construction or for operation or maintenance of plant. The asset account of plant and construction account may be subdivided into station construction, lines and poles, real estate, buildings, etc. The feature of the general accounts is practically no different from that of any other double entry bookkeeping system of accounts. The method in which this system may vary from ordinary methods of bookkeeping is principally in what may be known as the working accounts, and it is here that the formulation of the accounting and the determination to which account work under any given order shall be entered, arises. In the forms shown will be noticed the titles of sub-divisions of the working accounts representing expenditures. They show construction accounts, operating accounts and maintenance accounts subdivided into the various details, upon which it has seemed desirable to accumulate and record information. All orders issued involving expenditure recite thereon the account and sub-account to which the expenditures made thereunder are to be charged, and all returns of labor, material or expense incurred upon such order are reported, quoting the number of such order (all such orders being numbered serially). Expenditures which are continuous during the entire year, such as, for instance, labor and material and expenses for the operation and maintenance of the station, or labor and material required for the trimming and inspection of arc lamps and lines, may be dealt with by orders covering the entire year or parts thereof, say monthly, the latter being preferable. Monthly orders for work of this character are preferable to yearly orders, because as soon as the expenditure authorized under an order has been completed, such order is turned in to the office or bookkeeper, marked as completed, and thereafter no expenditure can be made chargeable to that order.

It will be observed that the purpose sought to be accomplished by these orders is the localizing and sub-dividing of the expenditures to the particular parts of the work being done upon which the management deems it necessary to have accumulated any specific information. In the forms submitted, there are sub-accounts representing different parts of the operation within the station, sub-dividing it into boiler room, engine room and the electrical generating room; similarly it sub-divides the work outside, the inspection, trimming of lamps, lines, the additions to the plant, whether within the station or outside, and also seeks to separate the different classes of service. It is, of course, important that the returns made upon these orders be in accordance with the instructions contained in the order. Thus, for instance, an order authorizing the inspection of lines should not have charged to it or reported against it the coal consumed under the boilers, and experience has demonstrated that employees very soon become accustomed to reporting and subdividing their work in accordance with the designations of the orders under which they are acting, so that in practice the allotment of expenditures for labor, material or other expense becomes automatic, with the result that the bookkeeper can indicate at any time the amount expended for any sub-account. By using subsidiary ledgers for this purpose, arranged similar to blank or Form No. 1, which, as will be perceived, is a re arrangement of the items upon the Form No. 2, and total up month by month or day by day as they may be recorded therein, the costs of each sub-account. Periodically, say monthly, the totals of these accounts are transferred either to asset accounts or to the debit of the revenue accounts, according to their character. The bookkeeper in debiting the returns on these orders to their various accounts, must make corresponding credit to certain other accounts; labor to credit of labor account; material or merchandise to credit of material or merchandise accounts, sub-divided as it may be; expense to expense account, and the totals of the credit of these accounts must, of course, balance with the totals debited to the accounts represented by the orders. When the labor is paid, the amount paid is debited to the labor account, thereby checking the accuracy of the pay rolls, which may be made up either from the returns upon the orders or by independent returns, but all labor represented by either the independent returns, time sheets or otherwise as may be used.

(Continued on page 110).

Forms Accompanying Paper on

CENTRAL STATION ACCOUNTING

From a Business Standpoint.—By P. H. HART.

SUBSIDIARY LEDGER.

Form No. 1.

GENERAL CONSTRUCTION.

INCANDESCENT INSTALLATION

DATE.		Real Estate and Buildings.	Office Furniture and Fixtur's	Maps, Instruments and Drawing		House Connecti'ns	Placing Trans-formers.	Placing Meters.	Meters Located.	Trans-formers Located.	Interior Wiring.	TOTAL
1895 JUNE												
JULY												
AUGUST												
SEPT.												
OCT.												
NOV.												
DEC.												
1896 JAN												
FEB.												
MAR.												
APRIL												
MAY												
1896 JUNE												
JULY												
AUG.												
SEPT.												
OCT.												
NOV.												
DEC.												
1897 JAN.												
FEB.												
MAR.												
APRIL												
MAY												
1897 JUNE												
JULY												
AUG.												
SEPT.												
OCT.												
NOV.												
DEC.												
1898 JAN.												
FEB.												
MAR.												
APRIL												
MAY												

Original size of Form, 11 x 14 inches.

Form No. 2

Class of Account GENERAL CONSTRUCTION.

Date.	ACCOUNT.	SUB-ACCOUNT.	Labor.	Material.	Total.
	Real Estate and Buildings				
	Office Furniture and Fixtures				
	Maps, Instruments and Drafting				
	Incandescent Installations	House Connections.			
		Placing Transformers.			
		" Meters.			
		Meters Located.			
		Transformers Located.			
		Interior Wiring.			
	Alternating Arc Installations	House Connections.			
		Placing Transformers.			
		" Meters.			
		" Lamps.			
		Meters Located.			
		Transformers Located.			
		Interior Wiring.			
		Lamps and Coils Located.			
	Arc Installations, City	Connections.			
		Lamps and Fixtures Located.			
		Placing Lamps and Fixtures.			
	Arc Installations, Commercial	House Connections.			
		Lamps and Fixtures Located.			
		Placing Lamps and Fixtures.			
	Series Inc. Installations, City	Lamps and Fixtures.			
		Connections.			
	Series Inc. Installations, Comm'l	Lamps and Fixtures.			
		Connections.			
	D.C. Motor Installations	House Connections.			
		Inside Connections.			
		Meters Located.			
		Placing Meter.			
	A.C. Motor Installations	House Connections.			
		Placing Transformers.			
		Transformers Located.			
		Placing Meters.			
		Meters Located.			
		Interior Wiring.			
		Placing Motors.			
	Lines and Poles	Incandescent.			
		Arc, City.			
		Arc, Commercial.			
		D. C. Motor.			
		A. C. Motor.			
		Alternating.			
	Subways and Conduits				
	Cables	Incandescent.			
		Arc, City.			
		Arc, Commercial.			
		Motor.			
	Tools	Incandescent.			
		Arc.			
		Motor.			
		Linemen's.			
		General.			
	Horses and Wagons				

Original Size of Form, 8×11 inches.

Form No. 3.

Class of Account STATION CONSTRUCTION

Accounts for Each Station.

Date.	ACCOUNT.	SUB-ACCOUNT.	Labor.	Material.	Total.
	Real Estate and Buildings				
	Steam Plant	Boilers.			
		Piping.			
		Engines.			
		Pumps, Condensers and Heaters.			
		Shafting and Pulleys.			
		Belting.			
	Electric Plant	Incandescent Dynamos.			
		Incandescent Switchboard and Instruments.			
		Incandescent Switchboard Connections.			
		Arc Dynamos.			
		Arc Switchboard and Instruments.			
		Arc Switchboard Connections.			
		D. C. Motor Dynamos.			
		D. C. Motor Switchboard and Instruments.			
		D.C. Motor Switchboard Connections.			
		Motors (in Station).			
	Station Tools	Steam Plant.			
		Electric Plant.			
		General.			
	Office Furniture and Fixtures				
	Testing Equipment				
	Interior Wiring				

Original Size of Form, 8×11 inches.

Form No. 4.

Class of Account—STATION OPERATING

Accounts for Each Station.

ACCOUNT.	SUB-ACCOUNT.
Rent	
Taxes	
Insurance	
Steam Plant	Fuel.
	Cartage of Ashes.
	Boiler Compound.
	Water for Boilers.
	Boiler Room Wages.
	Engine " "
	Oil and Waste
Electric Plant	Inc. Dynamo Tenders' Wages.
	Arc Dynamo Tenders' Wages.
	D. C. Motor Dynamo Tenders' Wages.
	Incand. Switchboard Tenders' Wages.
	Arc Switchboard Tenders' Wages.
	D. C. Motor Switchboard Tenders' Wages.
	Inc. Dynamo Brushes.
	Arc Dynamo Brushes.
	D. C. Motor Dynamo Brushes.
	Incand. Commutator Segments.
	Arc Commutator Segments.
	D. C. Motor Commutator Segments.
	Arc Blower Wings.
Arc Lamps, City	Oil and Waste.
	Carbons.
	Trimming.
	Inspecting.
Arc Lamps, Commercial	Carbons.
	Trimming.
	Inspecting.
Alternating Arc Lamps	Inspecting.
	Trimming.
D. C. Motor	Inspecting.
	Testing.
A. C. Motor	Inspecting.
	Testing.
Incandescent	Inspecting.
	Testing.
Lamp Renewals	Incandescent.
	Series Inc. City.
	Series Inc. Commercial.
Incandescent Lamp Changes	
Lines and Poles	Inspecting.
(to be subdivided where possible)	Testing.
Removing Lines and Poles	Incandescent.
	Arc, City.
	Arc, Commercial.
	Motor.
Removing Installations	Arc, Commercial.
	Arc, City.
	Incandescent.
	D. C. Motor.
	A. C. Motor.
	Alternating Arc.
	Series Inc., City.
	Series Inc., Commercial
Fire Patrol	Arc, City.
	Arc, Commercial.
	Incandescent.
	Motor.
Testing (in Station)	Inc. Lamps.
	Meters.
	Alt. Arc Lamps.
	General.
Accidents	
General Expenses	Clerks.
	Stationary.
	General.

Original Size of Form, 8 × 11 inches.

Form No. 5.

Class of Account—STATION MAINTENANCE

Accounts for Each Station.

ACCOUNT.	SUB-ACCOUNT.
Real Estate and Buildings	
Steam Plant	Boilers.
	Piping.
	Engines.
	Pumps, Condensers and Heaters.
	Shafting and Pulleys.
	Belting.
Electric Plant	Arc Dynamos.
	Arc Switchboard and Instruments.
	Arc Switchboard Connections.
	Arc Lamps in Station.
	Incandescent Dynamos.
	Incand. Switchboard and Instruments.
	Incandescent Switchboard Connections.
	Incandescent Lamps and Circuits.
	D.C. Motor Dynamos.
	D.C. Motor Switchboard and Instruments.
	D.C. Motor Switchboard Connections.
	Motors.
Lines and Poles	Incandescent.
	Arc, City.
	Arc, Commercial.
	D.C. Motor.
	A.C. Motor.
	General.
Installations Inc.	House Connections.
	Repairing Meters.
	Repairing Transformers.
	Replacing Transformers.
	Customers' Premises.
Inst. Alternating Arc	House Connections.
	Repairing Meters.
	Repairing Transformers
	Customers' Premises.
	Lamps.
	Globes.
Inst. Series Inc. Commercial	Lamp Fixtures
	Lamp Connections.
Inst. Series Inc. City	Lamp Fixtures.
	Lamp Connections.
	Lamps.
Installations Arc City	Lamp Fixtures.
	Lamp Connections.
	Globes.
Inst. Arc Commercial	Lamps.
	Lamp Fixtures.
	Lamp Connections.
	Globes.
Installations D.C. Motor	House Connections
	Customers' Premises.
	Repairing Meters.
Installations A.C. Motors	House Connections.
	Repairing Meters.
	Repairing Transformers.
	Customers' Premises.
	Motors.
Tools	Steam Plant.
	Electric Plant.
	Testing
	General.

Original Size of Form, 8 × 11 inches.

REQUISITION FORM

Form No. 6.

"Line Construction and Maintenance Dept." No.....

.....189

Stores Dept. will please CHARGE to .....*for order No*.....

TO BE CHARGED

Blocks, Side			
Bolts, Carriage,	⅜ x 4		
" "	½ x 5		
" "	½ x 7		
" Machine,	⅜ x		
" "	" x		
" "	" x		
" "	½ x		
" "	½ x		
" "	½ x		
Brackets, Cross, 2 pin			
" Flat, 2 pin			
" Hook, with nut			
" Leg			
" 3 "			
" Straight, 1 pin			
" " 2 "			
" " 1 " with nut			
" " 2 " "			
Braces for cross arms			
Boxes, Junction			
Cable			
"			
Cement, Roof			
Charcoal			
Cross arms, 2 pin			
4 "			
6 "			
Cut outs, Film			
Globes			
Hanging Straps			
Hangers, Iron Street			
" Goose-neck			
Hoods, Series Inc.			
Insulators, Guy			
Ordinary			
D. P.			
Porc.			
Lamps, double arc, 2000 c.p.			
" Single arc, 2000 c.p.			
" Series 32 c.p., 9.6 amp.			
" " 65 c.p., 9.6 amp.			
Naphtha			
Outriggers			
" Plates			
Pins, Oak			
Poles, ft.			
" "			
" "			
" "			
" "			
Rope, Manilla			
Resin			
Screws, Wood			
" "			
" "			
Forward,			

Forward,			
Screws, Coach			
" "			
" Cap			
Slings, rope			
Solder			
Spikes			
Tape, Grimshaw			
" Kerite			
Transformers,	Light	No.	
"	"	"	
"	"	"	
"	"	"	
"	"	"	
Turn Buckles			
Tubing			
Tripods			
Washers, 5-16			
" 7-16			
" 9-16			
" 13-16			
Wire, Rubber Covered			
" "	"		
" "	"		
" "	"		
" D. B.	4/0		
" "	3/0		
" "	2/0		
" "	0		
" "	1		
" "	2		
" "	4		
" "	6		
" "	8		
" "	10		
" "	12		
" "	14		
" "	16		
" Cable			
" "			
" "			
" Galv'd,	6		
" "	9		
" "	9 x 2 strand		
" "	9 x 3 "		
Received			
Delivered by			
D. B. Folio			

Original Size of Form, 8 x 11 inches

CREDIT

Form No. 6

No ..... "Line Construction and Maintenance Dept."

... .189

Stores Dept. will please CREDIT to ....*for order No*.....

TO BE CREDITED

Blocks, Side			
Bolts, Carriage,	⅜ x 4		
" "	½ x 5		
" "	½ x 7		
" Machine,	⅜ x		
" "	" x		
" "	" x		
" "	½ x		
" "	½ x		
" "	½ x		
Brackets, Cross, 2 pin			
" Flat, 2 pin			
" Hook, with nut			
" Leg			
" 3 "			
" Straight, 1 pin			
" " 2 "			
" " 1 " with nut			
" " 2 " "			
" Strap			
Braces for crossarms			
Boxes, Junction			
Cable, Lead-concentric			
"			
"			
Cement, Roof			
Charcoal			
Crossarms, 2 pin			
" 6 "			
" 10 "			
Cut-outs, Film			
Hanging Straps			
Insulators, Glass, Small			
" Ordinary			
" D. P.			
" Porc.			
Naphtha			
Outriggers			
" Plates			
Pins, Oak			
Poles, ft.			
" "			
" "			
" "			
" "			
Rope, Manillla			
Resin			
Screws, Wood			
" "			
" "			
" Coach			
" "			
Screws, Coach			
Solder			
Spikes			
Forward,			

Forward,			
Spikes			
Tape, Grimshaw			
" Kerite			
" Okonite			
Transformers,	Light	No.	
"	"	"	
"	"	"	
"	"	"	
"	"	"	
"	"	"	
" Straps			
" Stays			
" Tables			
Tubing			
Tripods			
Washers, 5-16			
" 7-16			
" 9-16			
" 13-16			
Wire, Rubber Covered			
" "	"		
" "	"		
" "	"		
" D. B.	4/0		
" "	3/0		
" "	2/0		
" "	0		
" "	1		
" "	2		
" "	4		
" "	6		
" "	8		
" "	10		
" "	12		
" "	14		
" "	16		
" Cable			
" "			
" "			
" Galv'd,	6		
" "	9		
" "	9 x 2 strand		
" "	9 x 3 "		
Received			
Delivered by			
D. B. Folio			

Original Size of Form, 8 x 11 inches

REQUISITION FORM.

Form No. 6.

Requisition No. **B** .....

Montreal..... .....*189*

On General Manager's Order No.....

	Class of Account.	Account.	Sub-Account.
For.....			
Debit			
Credit			

Received by.....*189* ..... *Foreman*

Delivered by..... .....*Supt.*

D. B. Folio... ..... *For use in*..... ..... *Dept.*

Posted .....

Original size of Form, 8 x 10 inches.

Form No. 6.

CREDIT.

Requisition No. **C**.....

Montreal..... .....*189*

On General Manager's Order No.....

	Class of Account.	Account.	Sub-Account.
For.....			
Credit.....			

Received by.....*189* .....*Foreman.*

Delivered by..... .....*Supt.*

D. B. Folio ..... *For use in*... .....*Dept.*

Posted.....

Original size of Form, 8 x 10 inches.

Customers' Record Book Form.

INCANDESCENT

For Month Ending June, 1899.

Cir. No.	Led. Folio.	NAME.	Date.	METER READ'G IN AMPERE HRS Present.	Consumed.	Meter Rental.	Total.	Led. Folio.	Date.

Original size of Form, 23½ x 18 inches.

Form No. 8.

LIGHTING DEPARTMENT

Ledger Folio.	Cl.	Customer	Discount. Incand.	A C Motor	Totals.	Lighting. Incand.	Com Arc	D C Motor Current	Rental.	Sales.

Original size of Form 20 x 15 inches

Note.—The Customer's Record Book Form and Form No. 8 should be read across the two pages.

Form No. 7.

CARD . . . . . .

INCANDESCENT METER CARD.

LED. FOL..... CONTRACT NO..... .....DATE.....

DATE OF CONNECTION } .....TERM.....EXPIRES.....

NAME.....

ADDRESS .....

BUSINESS.....

REMARKS .....

.....

METER NO.....CAP.....AMPERES

GOV. CERT. .....PER CENT. OF ERROR.....

CIRCUIT NO.....VOLTS.....

Lamps Installed.

DATE.	ORDER	5 C.P.	8 C.P.	10 C.P.	16 C.P.	32 C.P.	C.P.	TOTAL EQ. TO 16 C.P.

Original size of Form, 8 x 4½ inches.

Original size of Form, 8 x 4½ inches.
(Back of Incandescent Meter Card).

METER NO..... VOLTAGE..... RATE .....

REMARKS.	DAYS	Current Regist'd	READING.	DATE.	INSP.

Manager's Order Form.

NAME..... ORDER NO.....

ADDRESS ..... DATE.....

.....

THIS ORDER AUTHORIZES AND DIRECTS THAT .....

.....

.....

.....

.....

.....

.....

SIGNED.....GENERAL MANAGER

Return this Order as soon as completed, and report labor, material and expenses on following accounts.

CLASS OF ACCOUNTS.	ACCOUNT.	SUB-ACCOUNT.	Station	No. of Circuit.	

TO.....

REPORT HERE, REMARKS, ETC.

.....

.....

.....

.....

.....

.....

WORK COMPLETED, DATE .. ..

SIGNED BY.....

Original size of Form, 8 x 11 inches.

LIGHTING ACCOUNTS.

July, 1899.

METER READ'G IN AMPERE HRS				
Present.	Consumed.		Meter Rental.	Total.

August, 1899.

Led. Folio.	Date.	METER READ'G IN AMPERE HRS			Meter Rental.	Total.
		Present.	Consumed.			

CASH RECEIPTS.

CONTRACT AND SALES.			A. C. MOTOR.			RENTAL.			MISCELLANEOUS.	TOTAL.
Wiring.	Lamp Renewals.	Line Construction.	Current.	Rental.	Sales.	A.A Lamps.	Transformers	Poles.		

must balance with the accounts credited as above to labor account, and debited to the accounts represented by the various orders.

In the detail working under these orders through a number of employees, means of obtaining material and making returns under and to these orders become necessary, and where a large number of employees are engaged, these necessarily require the adoption of other forms or blanks, as, for instance, the requirement of material for the execution of any order necessitates that an application be made by the employee needing that material to the store room or storekeeper, where such material is kept on hand, or through whom it will be purchased if need be. In the system described, this becomes what is known as a requisition, blank No. 6, and in filling out such requisition the employee requiring the material quotes thereon the No. of the order on which he intends using it. Similarly in making returns of labor or time, the time ticket or labor return blank specifies the order No. authorizing such labor. Blanks or forms authorizing the return to storeroom of any surplus material that may have been taken out on an order, also recite thereon the order No. to which it is to be credited or upon which it is returned. In all these returns or reports, besides quoting the No. of the order, the accounting of such order is also recited, the object being to prevent the error of charging a wrong account through a mistake or transposition of the order numbers. Revenue accounts may also and in the system herein referred to are sub-divided or classified into various accounts of service from which the revenue is obtained, as, for instance, alternating current incandescent lighting, alternating current motor service, direct current motor service, arc lighting, etc., and this subdivision may be made as minute as desired.

Dealing with a large number of customers, it is important that means be adopted whereby none shall escape from the grasp of the bookkeeper or collector. Therefore no customer should be connected with the service lines except under an order, as above described, authorizing such connection and supply of the service called for. Upon completion of such order, it is returned to the bookkeeper, with notation thereon that connection has been made and supply of service begun. Meanwhile, that is as soon as the order to make connection has been issued, the contract signed by the customer upon which the order has been issued, is transmitted to the bookkeeper, who immediately opens in his ledger an account with such customer. On the return of the completed order, the bookkeeper notes in his ledger at the customer's account, the date of starting, which is also marked upon the contract. The customer's contract is not filed or put away or considered as being in operation, until such notation has been made. As an additional precaution, when the account is opened in the ledger, a card similar to Form No. 7 is prepared by the bookkeeper, giving the customer's name, address, ledger folio and number of contract (and all contracts are numbered serially), character of service, and generally the main details of the contract and service. This card is filed according to ledger folio, and accumulates the record upon which the debit side of the customer's account in the ledger is created. In cases where meters require to be read, these cards constitute the guide to the meter readers as to what meters are to be read. In sending out accounts to customers for service, every card must be accounted for by an invoice, and the fact of such invoice rendered noted thereon. In other words, the card is used to make out the invoice against the customer and the invoice is used to enter the account in the ledger, and every account in the ledger must be represented by an invoice.

The use of the method of making the entries in the day book and ledger from the invoice instead of making the invoice from the record book, is to hasten the transmission of accounts to customers, in order that they may not have any cause of complaint for delay in the opportunity to pay their accounts. In practice, the invoices are made out during the month as far as possible, leaving only the final entry to be made when the amount of the invoice has been determined, so that it becomes possible to transmit a large number of accounts within practically one day after the meter readings have been taken. The cards, in fact, constitute the history of the relations of the customer with the company, and at a glance show the variations in the use of service, for, as will be perceived, they are made to cover the year's transactions. They apply equally well for "flat" rate customers as for meter customers, though they are for recording meter readings. In the case of meter customers, they indicate the variations of use and afford a guide to the bookkeeper to enquire into the accuracy of the meter reading reported; any falling off or unusual increase in the use of the service as indicated by a reading immediately attracts the attention of the bookkeeper or billing clerk, thereby causing him to institute an immediate enquiry into its accuracy. In the case of "flat" customers, it declares at once the proper amount of the account to be rendered, by the record of the account previously rendered. The debits to customers are credited to the several sub-divisions of the revenue accounts, that is, the customer may be using several kinds of service, the amounts for which are debited to his account, but credited each to the revenue account to its individual class of service. This results in determining the revenue obtained during any period from each kind of service, the total of all, of course, representing the entire revenue obtained and offsetting the expenditures made therefor.

Companies having to deal with a large number of customers and various classes of service, and varying discounts, resulting from special or large consumption, will necessarily require for the convenience of the cashier, a secondary or subsidiary cash book in which can be noted the special discounts or allowances made, as well as the cash received for the various classes of revenue. A form of such cash book is indicated in blank No. 8. This cash book, or rather entry book, for the receipt of cash and discounts, applies only to discounts stipulated in the contract. Other allowances, rebates or credits are made only by authority of order issued specially therefor in each case.

Assuming this system of accounting to have been properly and carefully carried out to the end of the fiscal year, we would now have before us the total revenue from the business in its various classes. On the other hand, we would have the total cost of operation and maintenance, general expense and the total expenditure on capital account for the year; taking the total revenue derived and deduct from that the total cost of operation and maintenance, will give the gross profit. From this gross profit is to be deducted the general expense. The general expense account should include only such items as are purely general. By that I mean expense which cannot be charged to any specific working account, and is purely general in its relation to the business, such as interest, office expenses, directors' fees, salaries of officials, legal expenses, travelling expenses, for instance expenses incurred in attending Electrical Association conventions. Deducting the general expense from the gross profit will give the net profits of the business for the year, exclusive however, of depreciation. This question of depreciation is usually determined by the management. It always has been a much discussed question, and authorities find it very difficult to agree on a uniform method of application, the changing value of apparatus being so widely different. However, one of the definitions of depreciations, given by E. Hartley Turner as "The re-payment of capital out of the total gross revenue earned during a given period of such proportion of the original capital outlay as has been absorbed or consumed in earning such gross revenue" is very good, could the amount so absorbed be readily determined. A definite plan, however, is to apply to property in which a residue of value under any circumstances must remain, a graduated percentage upon its changing value as representing depreciation. The amount of this depreciation, however, will be governed to a great extent by the amount of the expenditure on maintenance account.

In the presentation of this paper, I have endeavored to follow out the question of Central Station Accounting from a business standpoint solely. With this in view, it has been confined almost entirely to the question of the method of ascertaining costs of generation and distribution, and recording from whence revenue has been derived and the methods of assuring the obtaining of all the revenue derivable. I have assumed that the important features are the knowledge of costs and the sources from which the revenue can be most profitably obtained. The question of purchase of material and the recording of these purchases have not been touched upon, this method being practically similar to all lines of business; neither has reference been made to the obtaining or keeping of records pertaining more particularly to the Engineering Department, for the reason that this subject has been exhaustively considered in a paper entitled, "Some Central Station Economics," submitted by P. G. Gossler at the annual convention held in Toronto in

1897. Whilst, no doubt, the system herein described may appear elaborate and extensive in detail, and perhaps seem to entail expenditure for labor beyond the reach or desire of managers of small stations, I see no reason why the principle involved may not be used in any station at a slight expense. For while perhaps not requiring to employ all the sub-divisions indicated upon the blanks or forms shown, yet many of them can be utilized and put into practice with such modifications as the local conditions demand without imposing upon the manager or employees any labor or expense beyond that which can be afforded, and if I have succeeded in conveying ideas and information that may serve towards the adoption of a general system of Accounting for Central Station practice as suggested by the authorities referred to in the beginning of my paper, I will feel myself amply compensated.

RAILWAY ENGINEERING.

The Engineering News, New York, says recently: "We here have presented in book form a series of articles on railway construction originally published in The Canadian Engineer. The author has had a long and varied practical experience in railway work; and while he quotes freely from the late A. M. Wellington's 'Theory of Location,' and from other standard works on this subject, his aim is to serve those who wish to acquire some general information on subjects heretofore separately treated. In the first chapter he deals with fundamental considerations and statistics, chiefly applicable to Canadian railways. Train, curve and grade resistance and their cost, and vertical and horizontal and transition curves are treated in the next two chapters. Under Surveys, we have the organization and methods for making reconnoissance, preliminary and final surveys, and some of the methods of passing obstacles. 'Roadbed Construction' covers waterways of various types, with designs for such structures and approximate cost, and includes large bridge foundations and the methods for sinking them; wooden trestles are treated at full length as still desirable where wood is abundant and other material unavailable. Foundations on land and in water are separately treated; the various methods are described and the approximate cost is given in many cases. The laying out and measurement of work is illustrated by diagrams and text, and notes are included on the methods of payment and classification of materials, etc. The sixth chapter deals with Canadian railway law, under the Railway Act; and Part II. of the book is devoted to track details. The work, taken as a whole, condenses into a small compass much information that will be useful to young railway engineers."

THE DART UNION COUPLING.

We call the attention of our readers to the advertisement that appears now for the first time in a Canadian journal, of the E. M. Dart Manufacturing Co., Providence, R.I. This company is engaged in the manufacture of several excellent steam appliances that have won their way to the front by merit. The most conspicuous is the Patent Union Coupling, which is claimed by all parties to be "the best." One of the illustrations in the advertisement shows the patented features, which will be readily understood by steam users. The connecting parts marked Dart Patent, April 1st, 1890, are made of bronze, the other parts are malleable iron. This company has supplied to the Brooks Locomotive Works, Dunkirk, N.Y., fifty thousand of these couplings in the past four years. These couplings are now being furnished to the largest industrial works, including locomotive builders, railroad companies, factories, breweries, ship builders, miners, steam fitters, gas companies, plumbers, and others, for use in connecting pipes, for the conveyance of steam, water, gas, oil, air, etc. The E. M. Dart Mnfg. Co., in offering to the people of Canada this excellent device, can give assurances, born of experience, that the meritorious features have been subject to the "crucial test of time," and no risk is taken in buying the goods. We learn that the company contemplates having these goods on sale with the prominent jobbing houses of Canada soon. All enquiries for prices and discounts will be promptly answered by addressing E. M. Dart Mnfg. Co., Providence, R.I., U.S.A.

LEAKING VATS.

Editor CANADIAN ENGINEER:

Will you kindly tell me what to apply to the inside of cider tanks to prevent the cider soaking through the wood. I have lost hundreds of gallons in this way, and can find no remedy.

[The only satisfactory method, so far as we know, is to apply a special enamel to the inside of the tanks, such as brewers use. We have sent you by mail the name of a dealer in brewers' supplies, whom we can recommend. Ed.].

SMOKE CONSUMPTION.

The Montreal Board of Trade has for some time used anthracite screenings as fuel in making steam for light and power. A forced draft is necessary to do this, which causes a considerable quantity of the ash, small particles of slate, and some unconsumed coal dust to escape at the top of the chimney in the shape of fine hard grit. This proved troublesome, not only to the Board of Trade and their tenants, but also to others in the neighborhood, and it was decided to at once put a stop to it. This has been accomplished most effectually in a novel manner, the sparks or grit as they leave the fire are caught and separated from the hot gases before they pass through the tubes of the boiler, thus preventing the accumulation of dust or ashes in the tubes and maintaining the boiler in its most efficient condition at all times. The sparks or grit, after being separated from the hot gases, are then immersed in water and conveyed outside the building by means of a special hydraulic conveyor, and are then separated from the water and are ready to be carted away. The water is then returned to carry out more ashes and grit. The system was thoroughly tested on one boiler for six months before being applied to the remainder of the plant, since which time it has been inspected by several prominent engineers, who all say that it is the best device for the purpose that could be thought of. John J. York, superintendent and engineer of the building, is the inventor of the system, and he is now preparing to take out patents on it.

CORRECTION.

In the issue of The Canadian Engineer for June, by a typographical error in John S. Fielding's letter on "Dam Building," the formula "$31.25h^{2}$" was made to appear as "$21.25h^{2}$."

THE V. & B. PIPE WRENCH.

Vaughan's improved positive grip pipe wrench combines lightness and strength, as well as durability, and its construction is the most simple, and the least complicated of any practical pipe wrench on the market. As will be seen from the above cut this wrench consists of only two pieces, which are drop-forged from bar cast steel; there is no malleable nor wrought iron used in its construction. It is solid cast steel from end to end; it has no threads to rust and wear out, nor springs to break; it cannot lock nor wedge on the pipe, and will release its grip instantly when the pressure on the handle is removed. The teeth are in a line tangent to the circumference of the pipe,

which combined with the oscillating angular toothed jaw, absolutely prevents crushing or slipping on the pipe. The jaws are oil tempered and the teeth can be sharpened with a file when dull. This wrench is especially adapted for use in limited spaces, such as narrow ditches, pump work in wells, pipe work for irrigation, wind mill pipe work, and for general use around agricultural machines. Every mechanic should have one. For screwing in stud bolts in steam pumps and engines. The makers claim for the V. & B. pipe wrench, simplicity of construction, combined with lightness and strength, and its positive rigidity when under a strain, and wherever it can be used

there is no wrench that excels it. Every wrench is warranted. This wrench is equally suitable for square and hexagon nuts, iron rods, etc.

Length.	Capacity.
10 inch pipe	⅛ to ¾
14 inch pipe	¼ to 1½
18 inch pipe	¼ to 2
24 inch pipe	½ to 2½

For discounts and further particulars address Aikenhead Hardware Co., Toronto.

NEW CATALOGUES.

Lundell Fan Motors, catalogue 66; Sprague Electric Co., New York. Jack & Robertson, Montreal, sole agents for Canada. This is a most attractive booklet of 40 pages, bound in green and gold, and profusely illustrated.

Electric Power—The Lundell Motor, Catalogue No. 58; The Sprague Electric Co., New York. Jack & Robertson, Montreal, sole agents for Canada; 70 pages; paper; illustrated.

Greenfield Flexible Metallic Conduit, Catalogue No. 63; Sprague Electric Co., New York. Jack & Robertson, Montreal, sole agents for Canada. This valuable specialty is very fully illustrated in some 20 pages, paper.

FIRES OF THE MONTH.

July 5th. Winnipeg Trunk and box factory; loss, $5,000; insurance, $1,200.——July 12th. Hourd & Co.'s furniture factory; loss, $8,000; insurance, $4,000.——July 24th. Str. "Mistassimi," on Lake St. John, Que.; loss, $50,000.——July 26th. J. F. Beckhan's saw mills, Holmes & Arpin's box factory, D. Gagne's door and sash factory and W. S. Scott's cabinet factory, Montreal; loss, $13,000.

LITERARY NOTES,

"Transformer Design;" a treatise on the design, construction and use of transformers, by Geo. Adams, A.I.E.E., A.M.I.M.E.; cloth, 75 pages, 34 diagrams: Spon & Chamberlain, New York.

The weekly news edition of the Street Railway Journal is a new and most welcome recruit to the ranks of technical journalism. This edition is devoted primarily to the publication of street railway news and current happenings related to street railway interests.

"A Practical Handbook on the Care and Management of Gas Engines," by G. Lickfeld, C.E., authorized translation by G. Richmond, M.E. This compact little volume also contains instruction for running oil engines. Cloth, 113 pages, illustrated: Spon & Chamberlain, New York, publishers.

"Small Accumulators; How Made and Used," is an elementary hand-book for the use of amateurs and students, edited by Percival Marshall, A.I.,Mech.E. This is a scientific handbook of great value to the class of readers for whom it has been specially prepared.

We have received the Transactions of the Association of Civil Engineers of Cornell University, Vol. VII., 1898-99. This volume contains addresses by non resident lecturers, miscellaneous papers, constitution and list of members of the association. Among others these are interesting papers; Notes of th Use of Concrete in Dams; Data of Stream Flow in Relation to Forests; Locks and Lock Gates for Ship Canals, etc.

Wallace Bentley, A.I.M.E., Halifax, Eng., is the author of a most valuable series of technical works. Rules and definitions specially arranged for the use of students in the engineering subjects is a surprisingly full store of exact information contained in so small a compass as to be very convenient for reference. In our column, "The Practical Man" we quote a few paragraphs on Toothed Gearing, which will show the reader the value of these works of reference. Questions in Applied Mechanics (with answers), is a companion volume, as is Questions in Machine Construction and Drawing. Sketches of Engine and Machine Detail, is a cloth bound volume of some hundred pages, each crowded with carefully prepared drawings of details which cannot but be of great assistance not only to technical students but to everyone who wishes an exact knowledge of engine and machine details.

We have on our desk the calendar of the School of Mining, Kingston, Ont., for 1899-1900, which contains a full announcement of the work of this progressive institution. Wm. Mason, Bursar, School of Mining, Kingston, Ont.

The illustrated supplement to the Nelson Miner presents a great variety of views of the town of Nelson and surrounding localities in its numerous illustrations, and in the text gives a good deal of information as to the people and places shown.

The Department of Public Works, St. John, N.B., has issued the Engineer and Superintendent's Report on Sewerage and Water Supply. This work is in charge of Wm. Murdoch, C.E., and all engineers must feel interested in the thorough manner in which everything is carried on. Mr. Murdoch's methods in cleaning the city water mains have been fully described in The Canadian Engineer in the past. We shall give some of the more recent results in the early future.

We have received from the Civil Engineering Society of Perdue University, La Fayette, Ind., the Proceedings of the Perdue Society of Civil Engineering, 1898. There are some interesting articles on irrigation problems, and a discussion of block asphalt under the title of The Coming Pavement. We learn that paving blocks of crushed stone and asphalt were first manufactured in San Francisco in 1869. Since that time the methods of manufacture and the necessary machinery have been perfected until it became possible to manufacture them at prices that would permit of competition with other pavements. For the past thirteen or fourteen years the tests of this pavement have proved that it was no longer an experiment. Baltimore has a sample of the asphalt block pavement that has been in use for fifteen years, and is still in good condition. The blocks are 4 in. by 4 in. by 12 in. in size, composed of about 85 per cent. crushed stone and 15 per cent. asphaltic paving cement and subjected while at a high temperature to a pressure of 120 tons to the block. The blocks weigh eighteen pounds each; they are laid crosswise of the street, making a pavement 4 inches deep. The cost is about $2 per square yard.

THE ROYAL ELECTRIC CO., LTD.

The annual meeting of the shareholders of the Royal Electric Company was held July 18th. Among those present were: D. Morrice, Lieut.-Col. Strathy, F. L. Beique, C. S. Campbell, H. B. Rainville, Herbert Wallis, G. F. C. Smith, A. F. Riddell, J. R. Meeker, G. R. Marler, John Date, Edwin Hanson, Frank Newman, A. Brunet, W. H. Browne, the manager; James Wilson, Mr. Morrison, G. H. Smithers, Edward Rawlings, H. G. Strathy, George Caverhill, and L. McI. Spackman.

The manager, W. H. Browne, made some explanations in regard to the operations of the company since its inception and during the past year. He said that, in the electrical business, inventive genius was so prolific that the plant or apparatus for manufacturing electricity soon became obsolete. Hence, during the existence of this company, $1,800,000 of equipment had become useless, or superseded by improved machinery and methods. The whole of that $1,800,000 had not been written off, but $600,000 to $800,000 had, and, while there was certainly a million dollars in the nominal assets, which was really not in existence for any practical purpose, he thought the proper thing to do was to distribute the loss over a number of years, as they had been doing. Speaking of underground conduits, Mr. Browne said the time was coming, and they soon must meet the necessity. The cost of total conversion from pole wiring to conduits would be $1,500,000, but entire conversion was not necessary, as in some of the residential quarters it was not called for. He explained that, notwithstanding the large outlay for conduits, the expenses of maintenance would be sufficiently reduced to pay the interest on the outlay. The prices of current in Montreal would not be reduced to the point consumers expected, even if the source of supply was the water power of Chambly.

Colonel Strathy nominated as directors the following gentlemen: Col. J. A. L. Strathy, D. Morrice, James Wilson, H. B. Rainville, R. Forget, J. R. Meeker, A. Brunet, F. L. Beique and George Caverhill.

From last year's board there were left out of this year's nomination, the following: Hon. J. R. Thibaudeau, A. R. Macdonell, H. S. Holt, Edwin Hanson and Robert Cowans.

Those nominated were elected, though D. Morrice and F. L. Beique refused to act. At a subsequent meeting of the directors, R. Forget was elected president, and J. A. L. Strathy vice-president.

The following figures are from the fifteenth annual report of the Royal Electric Company for the year from May 31st, 1898, to May 31st, 1899:

The gross amount for the year to credit of revenue accounts aggregated	$1,113,770 87
Expenditure for labor, materials, operation, maintenance, and general expenses	791,486 58
Balance	$ 322,284 29
Less interest and fixed charges	54,600 11
Net profit for the year	$ 267,684 18
There have been declared four quarterly dividends of two per cent. each to the total amount of	120,000 00
Leaving a balance of	$ 147,684 18
From which are to be deducted the following:	
Sundry debts uncollectible or of doubtful value, charged to profit and loss account	3,101 66
Depreciation of merchandise, and factory product, on hand	8,777 99
Apparatus and plant displaced and withdrawn from use, and of dimmution in values of sundry items of assets	123,870 16
Added to the credit of profit and loss account	11,934 37

HOT WATER HEATING.*

BY P. TROWERN.

In my last address I told you about the different plans which were adopted by the people in different countries, for heating their houses. The furnace and plans of laying the pipes, invented by Mr. Perken for heating large buildings in England and other countries were brought here in the year 1850 from London by Mr. Howard, to this asylum, and fitted by Mr. Garth of Montreal, and after I took charge of it in 1850 it did good duty for 34 years; in 1890 I began to change the coil furnaces for tubular boilers, in the main building; we have now only four furnaces left in cottages A and C, which I will soon change for two boilers, although they have worked well for the past cold winter, keeping 100 people warm, with 60 tons of coal. I told you that I would give you my reasons for changing. Fully twenty years ago I saw a good change could be made after making and repairing 100 coils, and every year the brickwork had to be repaired, and made new, which became expensive, and took so much of our time in the summer, which seemed so short, in keeping new work and repairs in order for the winter.

I have shown you in my diagram of the furnace that the two pipes at the back are the flow or hot water pipes rising out of the coils, inside and outside ones; the two in front are the return pipes with taps at the bottom and connected with each coil at the bottom. The pipes are connected with a cast-iron expansion cylinder, each one on a wooden pedestal in the ward; each coil has a cylinder; the flow pipe connects with the cylinder as near as possible in the ward, in the bottom so that the cylinder becomes very hot at times, the return pipe also connects with the cylinder in the bottom and extends around the rooms for about 500 feet of pipe, and returns in the same recess together to the coil. In this form the water is always moving around while there is any heat in the furnace or bricks.

We will now look at our middle ward, which is about 30 feet above our furnace, this 30 feet of 1-inch pipe will hold one gallon of water at about 40 deg., or 10 lbs., and when heated to 212 deg. it will expand so that 21 gallons becomes 22, one gallon or 10 lbs. will become with the water in the cylinder 1534 gallons; the cylinder, however, is not always kept full, and if the return water be reduced in heat by one-half of the degrees it will be increased in weight by $3^1/_2$ lbs. (say 3 lbs.), which gives the motion to the return. If the 500 feet of pipe lies horizontally in the recess, not having a fall to the furnace, it will reduce the weight and motion in getting back to the coils; so you see what a small weight or force we have to keep up the circulation. We will now go to a ward about 30 feet higher, 60 feet above the furnace. These cylinders and pipes work better because of the height and weight being increased. Here we will observe the air is not admitted to the water anywhere, but when we pump in any to make up for waste, we after a while let out, by opening the tap above, whatever air may have gone in with it, and also any steam which may have formed on top of the water, we fill and supply them all with the pump. We will now go to the dome tank, 15 feet above, or 75 feet above the furnace; a cylinder and a coil of 1-inch pipes around a 20-foot diameter and 6 foot deep tank of water supplied by city waterworks. This furnace worked well, but the pressure was so great the coils would not or did not stand the same length of time as the others, because we had to keep a larger fire, the coils being larger and the pipes connected being about 1,000 feet each. We will now go to the basement. The expansion cylinders are about 15 feet above the furnace; and the 500 feet about 3 feet above the furnace; this gave more expense and labor to keep going than any other, one reason was, I was obliged to return the water to coils in the furnace under the floor and below the top of the furnace. I then lowered the furnace but found it too wet for the fire to burn well and raised it again; here I began to see that if I put in a boiler large enough I could stop four fires and have one to do the same amount of work much better, and get the same amount of pressure alike in all the coils by having an expansion of 100 gallons up by the large tank, and instead of supplying them with a pump I could supply them from the tank 75 feet above, 35 lbs. pressure; I then drew a plan for a 40-inch boiler, 8 feet long, with two 11-inch flues for the heat after passing under the boiler to come to the front and then go back to the smoke pipe behind on top of division plate through sixteen 4-inch tubes. I had a division plate behind and a smoke box in front; I had holes tapped in the top and sides for 1-inch pipes, the same pipes which were connected with the coils I connected with the boiler, but the expansion cylinders in the wards were full, and became a part of the heating pipes; I took up to the expansion cylinder two pipes, one flow and one return. The water in the cylinder is about the same level as in the tank, and a pipe from the bottom of the tank to supply the boiler with a check valve and supply tap near the side of the boiler, each pipe has a cut-off tap so that if any dirt or scales choke the pipes in the wards, we drain the pipes and cylinder, and then let on the full force, on the top of the expansion cylinder. Up by the tank we have a relief pipe to discharge into the tank should a large fire be put in too quickly; the first boiler has been working for the last ten years without any repairs or changes, the same set of bars, burning hard coal, large egg.

We have now in the Toronto Asylum for the Insane, ten heating boilers and seven for giving hot water and four coil furnaces for heating in the two cottages, and three boilers for our greenhouses.

*From a paper read before the Canadian Association of Stationary Engineers.

—Sixty of the rollers and heaters in the forge department of the Ontario Rolling Mills, Hamilton, Ont., struck, July 3rd, demanding, it is understood, sixty cents more a ton piece work. The men's demands were granted, and they returned to work in a couple of days.

—The construction of a canal between Lake Ashawaken, on the head waters of the Ottawa, to a point on the Gatineau river, a distance of some seven or eight miles, is being discussed. A large portion of the distance is watered by small lakes, leaving but a few miles of actual canal to be excavated. It is claimed that the freshets on the Ottawa are not of sufficient duration to take out the timber from the far northern regions in one year, and that no lumberman would hold limits and pay dues under these circumstances. The line of the proposed canal is just about twenty miles south of the height of land, latitude 48, and longitude 76, or about one hundred miles north of the present farthest north operations. Altogether the canal would, it is said, open up for operation about ten thousand square miles. It is rumored that the project may be laid before the Quebec Government for the purpose of obtaining a subsidy.

CANADIAN ASSOCIATION STATIONARY ENGINEERS' CONVENTION.

The convention opens at Berlin, Ont., August 15th.

The following is the official programme: Tuesday, August 15th.—11 a.m., reception of delegates, Mayor's address of welcome; 2 p.m., meeting of committees.

Wednesday, August 16th.—9 to 12 a.m., general business; 2 p.m., reading of papers and discussions; evening, open air concert by B.M.S. band in Victoria Park.

Thursday, August 17th.—9 a.m., business of convention continued; 2 p.m., election of officers and other business; 9 p.m., banquet at the Walper to the officers and delegates.

ARCHIBALD W. SMITH.

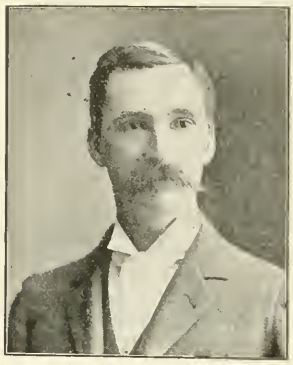
The publishers of The Canadian Engineer have pleasure in announcing the addition to its staff of Arch'd W. Smith, so well and favorably known for some years past as manager of the engineers' supplies and machinists' tools department of the Aikenhead Hardware Co., Adelaide street, Toronto. Mr. Smith was born in Quebec city in 1870, and attended the public and high schools of that city till 1884, when he entered the employ of Herman Young, now H. & J. Young, Quebec's leading hardware house. While in the service of this house Mr. Smith

ARCHIBALD W. SMITH.
C. H. Noble, Toronto, Photo.

was associated with W. H. Wiggs, founder of the Mechanics' Supply Co., Quebec, and to him he owes very much of his subsequent success in handling the large business in engineers' supplies and machinists' tools, which he has just left for newspaper work. In 1890 Mr. Smith came to Toronto, taking a position with Aikenhead & Crombie, and later when the business of this firm was taken over by the Aikenhead Hardware Co. Mr. Smith took charge of the department of machinists' tools, engineers' supplies and kindred lines, which has so flourished under his care as to fully justify the company in styling itself "Canada's leading tool house." Just previous to leaving the Aikenhead Co. Mr. Smith was presented with a beautiful gold chain and locket by Wm. Martin on behalf of the employees of the company. Thos. E. Aikenhead spoke on behalf of the company, expressing regret at the severance of a connection which had not only been very pleasant but materially profitable.

SURGEON-LIEUTENANT T. A. BERTRAM.

The town of Dundas, Ont., has long been known as the headquarters of the famous machine tool builders, John Bertram & Sons, and of recent years it has added the distinction of being the home of Canada's best marksmen. The two circumstances have also some relation for Pte. Hayhurst, who captured the Queen's Prize some years ago, was employed by John Bertram & Sons, and Surg. Lieut. Bertram is John Bertram's son. T. A. Bertram is 33 years of age, and was born in Dundas. He received his education at the common and high school here, when he went to Queen's University, Kingston, Ont., where he graduated and received his M.D. in 1886. He then went to London, Eng., and pursued his studies, and also attended the Royal College of Physicians and Surgeons, Dublin, where he graduated. On returning to Dundas, he went into partnership with Dr. Holford Walker for a few years. Afterwards, Dr. Walker retiring, to establish his present hospital in Toronto, he continued his Dundas practice. Dr. Bertram's brothers, Major Alex. Bertram and Staff-Sergt. Henry Bertram, members of the firm of John Bertram & Sons, are also good shots at the ranges. Dr. Bertram is a keen curler and has always distinguished himself in contests with



SURGEON-LIEUTENANT T. A. BERTRAM.

other clubs, bringing honor to the Dundas club. While at Queen's University he distinguished himself as an athlete, carrying off the championship cup for two successive years. The following is the record made by Dr. Bertram at Bisley: Queen's prize, place 26, £12 and badge; St. George, £2; All Comers' Aggregate 1st. cup valued at £250 and £15 cash; Corporation City of London, 1st prize, £25; Grand Aggregate Dominion of Canada Challenge trophy and National Rifle Association gold cross and £20, entitling the winner to have the letters G.C. after his name; Volunteer Aggregate 1st prize, Hop Bitter Co.'s challenge trophy and £15; Daily Graphic, 6th place; £5 and three framed sketches valued at 10 guineas each. In the Graphic, Daily Telegraph, Martin's Challenge Cup and other events he won a number of prizes. In the unlimited series he won £13. All the winnings in the above list are divided amongst the team, excepting the last one. Following are the scores made by Dr. Bertram in the principal competitions, together with the possible scores:

Grand Aggregate, 360 out of possible 385.
Volunteers' Aggregate, 164 out of possible 175.
All Comers' Aggregate, 196 out of possible 210.
Queen's, 324 out of possible 380.
Martin's Cup, 34 out of possible 35.
Alexander, 66 out of possible 70.
St. George's, 65 out of possible 70.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain of interest to the metal trades in June, 1898-99 and the six months ending June, 1898 and 1899:—

	Month of June,		Six Months to June	
	1898	1899.	1898.	1899.
Hardware	£1,416	£1,855	£10,312	£9,450
Cutlery	4,797	5,150	19,497	26,120
Pig iron	384	1,618	6,158	5,049
Bar, etc	1,516	2,192	5,650	5,716
Railroad	–	8,188	6,072	20,695
Hoops, sheets, etc.	4,005	16,177	16,255	38,835
Galvanized sheets	3,187	11,087	23,845	30,403
Tin plates	11,319	22,718	71,052	77,004
Cast, wrought, etc., iron	1,086	5,279	14,309	17,515
Old (for re-manufacture)	1,571	1,086	3,075	1,659
Steel	3,513	6,021	27,642	30,547
Lead	4,127	6,821	11,032	21,469
Tin, unwrought	1,505	2,250	9,673	9,517
Alkali	4,238	3,365	20,872	16,002
Cement	1,703	3,692	9,883	12,705

Industrial Notes.

The Copper Crown Mining Co. is building a smelter at Pictou, N.S.

Welland, Ont., will spend $8,000 on a town hall, not $2,000, as stated in a former issue.

James Fleming, St. John, N.B., has the contract for the boilers for the new Cushing pulp mill.

The International Convention of the Brotherhood of Locomotive Engineers met in St. John, N.B., July 27th.

A by-law for raising $40,000 for the building of a waterworks system in St. Mary's, Ont., was carried July 24th.

The Georgian Bay Cement Company is building a switch from the main line of the C.P.R. to William's Lake.

The National Iron Moulders, in convention at Indianapolis, U.S., have selected Toronto as the place of next meeting.

In boring for oil at Athabasca Landing, natural gas has been struck at a depth of 1,800 feet. The flow is large and very steady.

John Addison has bought the East Hamilton Co.'s property, Hamilton, Ont., including the East End Incline Railway and 40 acres of park, for $22,000.

A. E. Domville, of the St. Thomas Car Wheel Co., has been made a director in the International Car Wheel Co., lately formed, with a capital of $15,000,000.

W. B. Cleveland, T. A. Neef, and H. M. Stowe, of the Protected Rail Bond Co., of Cleveland and Philadelphia, are looking for a suitable location for a factory.

The International Correspondence Schools, Scranton, Pa., U.S.A., are offering special courses in mechanical and architectural drawing, book-keeping, stenography, and the English branches.

The Dowling Milling Co., Edmonton, N.W.T., has placed an order with The Goldie & McCulloch Co., Ltd., Galt, Ont., for the machinery in a new 175-bbl. flour mill, including engine and boiler.

Two large 400 or 450 h.p. cross-compound Wheelock engines, built by The Goldie & McCulloch Co., Ltd., Galt, Ont., have recently been placed in the power house at Bond Lake, Ont., for the Metropolitan Street Railway Co.

It is reported that Charles Leonais, Montreal, has sold several large tracts of spruce limits, situated on the north shore of the St. Lawrence, below Quebec, to a United States syndicate, for a large sum. Saw and pulp mills are to be constructed.

The Asbestos and Asbestic Company has taken out a writ of injunction against the William Sclater Co., alleging that the company defendant unduly uses the word "asbestic," to which plaintiff claims to have a sole right. The sum of $10,000 damages is also demanded from defendants.

J. W. Pyke, T. P. Howard, W. Ross, B. Shepherd, and R. A. E. Greenshields, Montreal, have received a Quebec charter as the Eclipse Acetylene Gas Company, with a capital stock of $50,000, to manufacture and construct machines used in the production of acetylene gas from calcium carbide.

The St. Thomas Times professes to be informed of the conditions on which the Standard Oil Company of the United States has gathered in the Ontario Natural Gas and Oil Company that has controlled the gas fields from which Detroit homes are being supplied with natural gas. The purchase price, it says, was $600,000, and, as there are only 25 shares, which sold in the original company at $600 each, the stockholders realize $24,000 for each share.

At Calumet, on the Ottawa river, about fifty miles above Ottawa, says The Montreal Star, there is a large floating sawmill, operated by steam and equipped with the most improved machinery; it can be floated anywhere there is a sufficient depth of water. This mill is owned by J. H. Dansereau, Vercheres, Que. His object in constructing the mill was to do away with the cost of towing logs from the mouths of the different tributaries of the Ottawa, between Ottawa and Grenville.

James Clemes is locating a saw mill at Grand Prairie, B.C.

A large pulp mill is to be built it is said by M. Menier at Macastey Bay, Anticosti.

S. F. Peters is architect of the new College of Pharmacy building, Winnipeg, Man.

Stewart & O'Leary have the contract for section 4 of the main drain, Ottawa, at $91,177.

It is reported that a Portland cement works will be established at Winnipeg this year by S. Walker.

Owen Sound Portland Cement Co., has just put in a 400 h.p. compound Goldie & McCulloch engine.

William Kennedy, Sons & Co., Owen Sound, Ont., are building a new moulding shop and enlarging their plant.

The Department of Lands and Works, Victoria, B.C., is building schools at Greenwood, Ashcroft, Slocan, Revelstoke and Fernie, B.C.

A by-law in aid of artificial stone works, which Arthur Jarvis proposes to establish in Belleville, Ont., is to be submitted to the ratepayers.

I. Matheson & Co., Ltd., New Glasgow, N.S., are running their plant night and day. This firm is now maker in Canada of the famous Case propellors.

The erection of a condensed milk factory is engaging the attention of some of the Sussex, N.B., citizens and may result in the establishment of such a plant.

The stove mounters in the stove foundries in Hamilton have had their wages advanced during the past month; in some cases the advance amounted to 25 per cent.

The plumbers' strike, Winnipeg, has been practically settled by the acquiescence of nine out of the ten employing concerns in the city to the wages asked by the men.

The large brick addition to the R. McDougall Company's moulding shop, Galt, Ont., is about finished. Other enlargements are contemplated on this property.

Cowan & Co., iron founders, Galt, Ont., will shortly commence the erection of a large addition to their works. It will be about 140 feet long, two stories high.

Wood Bros., Brantford, Ont., are turning the old Bain wagon works, recently vacated by the Verity Plough Co., into a flour mill; capacity, 100 to 200 bbls. a day.

The Hardill Compound Engine Co. of Mitchell, Ont., Ltd., has been chartered to make the Hardill compound engine; chief place of business, Mitchell, Ont.; capital, $40,000.

H. C. Cox, H. Sutherland, W. H. B. Aikins, T. R. Clougher, and R. H. Warden, D.D., have been incorporated as the Canadian Camera and Optical Co., Ltd.; capital, $150,000.

The MacGregor-Gourlay Company, Galt, Ont., is raising the roof of its moulding shop 8½ feet. The building is 104 x 40 in dimensions. The offices of the firm will also be remodeled.

F. S. Henning a marine engineer, and William Pigott, a painter, Toronto, have invented a fire escape which is a species of hydraulic elevator on the exterior of the building.

J. Lee, W. P. Robinson, W. H. Jenkins, W. Kemp and Nellie T. Clement, Woodstock, have been incorporated as the Caster and Metal Stamping Co., of Woodstock, Ltd.; capital, $5,000.

A bridge is to be built over Thunder Creek, near Shellmouth, Manitoba, including the erection of two stone piers, and the necessary grading of approaches. Wm. S. Wallace, Shellmouth, is the clerk.

J. Patterson has finished the plans for Shurley & Dietrich's iron and brass bedstead factory, Galt, Ont., which will be erected on a plot of land adjoining the firm's saw works. The new buildings will be of stone.

The recently organized Berlin Rubber Mfg. Co., of which Jacob Kaufman is president, George Schee, manager, and A. L. Breithaupt, secretary treasurer, is now getting in shape to manufacture rubber shoes.

R. N. Sterling, F. S. Jackson, J. W. Ball, Phoebe Jackson, and R. F. Massie, Toronto, have been incorporated as the Diamond Machine and Screw Co., of Toronto, Ltd., to carry on the business of the Diamond Machine and Tool Co.; capital, $75,000.

The Trent Valley Peat Fuel Co. has its plant running on the Balsam Lake division of the Trent Canal. W. J. Sims is manager. In operation the plant is found to be even more economical than the promoters claimed.

The Pierre-Mahy Glass Works Co., Rahnsart, Belgium, will probably organize a branch to manufacture glass in Chatham, Ont. Local capital will be enlisted to the extent of about $30,000, half the proposed capital.

The Georgian Bay Portland Cement Co., Ltd., Owen Sound, Ont., is installing a 300 h.p. Goldie & McCulloch engine, and a large amount of other machinery. M. Kennedy is president of this company, and James Maitland secretary.

C. F. Sise, R. Mackay, C. Cassils, R. Archer, H. Paton, L. B. McFarlane, C. P. Sclater, Montreal, have been incorporated as the Wire and Cable Co., Ltd., to make brass, copper and other metal wires, cables, etc., and to make electrical supplies; chief place of business, Montreal; capital, $100,000.

The Canadian Office and School Furniture Co., of Preston, has extended its factory and put in new machinery which will increase the capacity of the works by one-third. The company has orders for the seating and interior fittings of the new seminary chapel of Quebec, and for the new court house at St. Thomas, Ont.

Brown & Sharpe Mnfg. Co. has issued an illustrated wall card, which should hang in every workshop aiming at turning out the best work. The card shows the leading lines of these famous tools, and carries also a pad of reference tables, which are of great value to mechanics. They include, decimal equivalents; inches, also millimeters; the sizing and cutting of gear wheels; circular and decimal pitches; tapers per foot and corresponding angles; drill list for machine screw tops; decimal equivalents of the numbers of twist drill and steel wire gauges.

Robert Bell, Jr., proprietor of the Hensall Engine and Machine Works, Hensall, Ont., has completed a large machine for making bricks composed of sand and cement. The manufacture of this particular style of machine is, Mr. Bell says, the filling of a long-felt want in localities where brick clay is not found; that bricks made of sand and cement are, in many respects, superior to those made of clay, possessing a handsomer appearance, and can be produced at about the same cost. The machine alluded to has been tested and proved satisfactory, and has been forwarded to destination at Vancouver, B.C.

The Buffalo and Fort Erie Bridge Co. is building the only foot and vehicle bridge above Niagara Falls. The bridge, or practically two bridges, is to cross the Niagara from a point between Buffalo and Tonawanda, to Grand Island across the island, and on to the Canadian shore. The eastern section was the one for which legislation was obtained from the American Government in October, 1898. The location of the bridge has been approved by the War Department of the United States; the contract has been let for $1,485,400, and already several piers have been built. The Canadian section will cross from the opposite side of Grand Island, to a point in Welland County.

The increased trade of the Dominion Bridge Company has decided the management upon building an addition to their works at Lower Lachine, Que. Throughout the United States and Canada the iron and steel business has for some months been growing in tremendous proportions, and the Dominion Bridge Company now feels the necessity of enlargement in order to meet the increased demand. The new addition to the works, which will be completed in about two months, will give the company an increased capacity of from 7,000 to 8,000 tons per year, or about forty per cent increase on their present output. When the new buildings are in operation, the company will employ from sixty to eighty additional men.

The old established business of Wm. Hunter, brass founder, Hamilton, has been taken over by J. N. Tallman & Sons, who intend to maintain the reputation of the founder while extending the scope of the business. This they are well qualified to do, as Messrs. Tallman & Sons are experienced brass and iron founders, and understand every department of their trade, and are men on whom the fullest reliance can be placed. Since taking hold of the business they have put in a new electric motor, a water mill, a babbitt metal furnace and other plant, greatly improving their facilities for turning out work promptly. While maintaining the old firm's reputation for first-class babbit metal, the new firm will pay particular attention to special brass castings.

The Northey Manufacturing Co., Toronto, has under consideration a change which, if made, will result in an addition of $250,000 to the present capital of the company, and will involve the employment of at least 150 additional men, and possibly 500. The move which is contemplated is an amalgamation with a large Montreal firm which manufactures hydraulic and other machinery. A third company may also be induced to join forces with these two and to locate in Toronto. This would bring the total capital of the company up to $150,000. The Northey Company has been steadily increasing its sales of late, and is now sending machinery in large quantities to the Maritime Provinces and British Columbia, in addition to having a very large trade in Ontario.

Owing to the rapid growth in their business, Darling Bros., "Reliance Works," Montreal, have erected an extensive addition to their machine shop. The new building is a substantial brick two-story structure fronting on Ottawa street, adjoining the original premises, and occupies what was formally yard room. It affords some five to six thousand more square feet of floor space. The lower flat has a solid cemented flooring, with the latest slow-burning process of ceiling. The assembling will be done on this flat, where a driveway enters the western end, and where travelling cranes are used for taking up completed work from any part, and expeditiously loading it for delivery. The blacksmithing work will be done in this fire-proof department. The business offices are on the second story, entering by a broad stairway from Ottawa street, and are handsomely finished in oiled wood, and comprise a general office, private offices, draughting room, lavatories, etc., all well lighted. The equipment of the whole shop is of the most modern character.

As noticed recently in this Journal, the engine-building plant of A. J. Nie (previously the Osborne, Kieley Co.), Hamilton, has been purchased by the Smart-Eby Machine Co., composed of W. G. Smart and J. E. Eby, who have reorganized and extended the business and are now turning out large orders in the engine and machinery line. Mr. Smart was, until the present connection was formed, with the Jenckes Machine Co., of Sherbrooke, and Mr. Eby was for some years with the McGregor, Gourlay Co., and Cowan & Co., of Galt, having been manager of the latter firm. The new firm has set to work energetically and has made quite a success of one of its specialties—the Webster engine for gas or gasoline, of which it has the sole right of manufacture for the Dominion. The firm makes also electric light high-speed engines, pumping machinery and special machinery to order. Orders are now being filled for the Canadian Colored Cotton Mills, the dyehouses of which are now being enlarged. The firm will be pleased to send their catalogue to anyone interested in gas engines.

From April to the end of July the aggregate value of building permits issued to manufacturing establishments in Toronto was $283,300, making a total of $535,000 from June, 1898, to the end of the same month this year. Among the firms who have expended during the past year or are now expending large sums on factory additions or new factory buildings in Toronto are, the Massey-Harris Company, $28,000, on new works; the Allen Manufacturing Company, $30,000; and J. B. Kay, $30,000; the Toronto Carpet Company, $50,000; the T. Eaton Company, $21,000; S. F. McKinnon, $52,000, for buildings and warehouses; the Carling Brewing Co., $12,000; Wilson, Lytle & Badgerow, $16,000; the Gerrard Heintzman Co., $14,000; Christie, Brown, & Co., $25,000; Brown Bros. Co., $40,000; the Toronto Type Foundry, $20,000; the Henry Kent Estate, $20,000; John Patterson, $15,000, the Consumers' Gas Co., $25,000; George Weston, $15,000. Other manufacturers have expended all the way from $1,000 to $10,000, while the soap factory to be erected by Lever & Co., it is estimated, will cost over $100,000.

Electric Flashes.

The Nelson Electric Tramway Co., Ltd., Nelson, has been incorporated.

Barrie, Ont., is installing a 150 h.p. Wheelock engine as part of its electric light plant.

The Holmes Electric Protection Co., Montreal, has been taken over and will in future be operated by the District Telegraph Company, under the general management of John Murray.

St. Thomas council has made a ten years' contract with the St. Thomas Gas Co. for lighting the streets with the Adams-Bagnall lamps of 2,000 c.p. at 25 cents per night, or 26 cents on a moonlight schedule.

The Peterborough Light & Power Co. is building its new power house, which is to be finished in October. It will be of brick and steel, 36 x 55 feet, and from it will be developed 1,500 h.p.

The Montreal Railway Co. has adopted the fender invented and patented by G. W. Sleman, Guelph, Ont., which the management consider the best fender brought to their notice. It is used on the cars in Guelph and has been recommended to the Toronto Street Railway by the Toronto city engineer.

A new company, to be known as the Lorette Electric Light and Power Co., has been formed at Lorette, near Quebec, and will undertake the lighting of that village and of the Indian and parish churches; $2,500 has been subscribed and the capital stock will be $10,000.

The Bear River, N.S., Electric Light and Power Co. is making arrangements for extending its services to Digby and intermediate points. This has necessitated the increasing of the capital stock to $75,000, and will probably involve the purchase of the plant at Digby, owned by Major Daley.

Letters patent have been issued incorporating W. H. Coleman, Andover, Mass.; A. J. Gordon, North Hatley, Que.; F. E. Lovell, Coaticook, Que.; Jacob W. Barnard and John H. Champion, Andover, Mass.; W. D. Currier, Lawrence, Mass., as the Eastern Townships Electric Co.; capital, $300,000.

The Light, Heat & Power Co., of Lindsay, is constructing its long distance transmission plant. The current will be carried from the company's water power at Fenelon Falls, a distance of 14 miles, into Lindsay and will be completed in October. The company will have 1,200 h.p. available from the new works.

Thomas Maynard has been appointed chief clerk in the master mechanic's office of the Grand Trunk Railway works, Montreal, vice Donald Robertson, who has resigned after a service of over twenty years as chief clerk in this department, to accept the position of assistant to manager and engineer Wanklyn, of the Montreal Street Railway.

Robert Surtees, C.E., of Ottawa, has made a report on waterworks and electric light for the village of Shawville. The cost of a waterworks system is given at $11,000; electric light, $4,000. The engineer estimates that waterworks would give a total yearly revenue of $1,273, while that from electric light would be no less than $1,900. At present Shawville is without fire protection.

In the Divisional Court, Toronto, recently, Chief Justice Meredith and Justice Rose gave judgment in the case of Kirkpatrick vs. Cornwall Electric Street Railway Company, an appeal by defendants from judgment of Chief Justice Armour in favor of plaintiff in a mortgage action for foreclosure and payment of $100,000. They held that the mortgage was valid, but that that part of the judgment directing payment of principal, interest and costs, must be struck out.

The B. F. Sturtevant Co., whose well known "chimneyless" factory is situated at Jamaica Plain, near Boston, Mass., is making an addition to its already large floor space for electrical work. Another story is being added to two of its shops, one 125 feet by 50 feet, and the other 100 feet square, both of which will be used for this purpose. The increase in this department has been enormous. The company is now making electric motors up to 125 h.p., and generators up to 100 k.w.

The Bell Telephone Co. is burying its wires in the principal streets in Hamilton.

W. B. Cleveland, F. H. Neff and H. M. Stowe, Cleveland, are said to intend starting an electrical supply factory in the old Wanzer building, Hamilton, Ont.

The Penfield and St. George Telephone Co. is applying for a New Brunswick charter, S. L. Dakin, L. Conners, Beaver Harbor, N.B., and John Doyle, St. George, N.B., are directors; capital, $2,000.

Dr. Pyne and H. M. East asked the use of Toronto streets to distribute power from the Anglo-American Electrical Supply Company to private consumers at 1½ cents per h.p. per hour. They say they would produce power within 18 months.

J. C. McLachlan, G. McLachlan, C. Millar, C. W. Vernon and R. B. Orr, M.D., Toronto, have been incorporated to deal in electric apparatus, gas engines and autocars as the McLachlan Electric and Gasoline Motor Co., Ltd.; capital, $39,000; chief place of business, Toronto.

The Deschenes Electric Company denies the story which has been started that the Metropolitan and Deschenes Electric Companies have formed an alliance and that the Metropolitan Company had bought out the water power of the Deschenes Company. W. H. Taylor, secretary-treasurer of the Deschenes Electric Co., stated that there was nothing at all in the story.

The Hamilton and Lake Erie Power Co. have renewed their offer to the city of Toronto for the supply of electric power for lighting and pumping purposes. In a letter to the mayor, S. C. Biggs, president of the company, says that nothing has been done in this matter and that the continuation of the delay will result in the loss of thousands of dollars annually in the next lighting contract. He says that his company can show to the satisfaction of council their ability to carry out any contract they may make.

W. J. Poupore, M.P., has a very extensive contract with the Lachine Rapids Hydraulic and Land Co. The contract will include the addition to the present wing dam of one thousand feet. This was included in the original plan, and the original charter from the Government provided for it, but the company only constructed a certain portion of it to see how they would get along, and now they find it necessary in order to get into deep water. The work is to be finished by the first of December next.

The City Council, Montreal, recently decided to request the city attorneys to take action to compel the Lachine Rapids Hydraulic & Land Company to remove their lights from the incinerator. A contract was given to the company to light the incinerator, and after the contract had been completed it was found that the Royal Electric Company had the right under its street lighting contract to furnish all of the electric lighting required by the city departments. As a result both companies have been maintaining lights at the incinerator and charging the city for them.

Some time ago American capitalists purchased the controlling stock in the North American Telegraph Company, owned by the Folger Brothers and the Rathbun Company. The telegraph company has been in existence twenty years and owns 1,000 miles of poles and from 3,000 to 4,000 miles of wire. W. Bampfield, of Montreal, has been appointed general manager by the new company in place of R. C. Carter, who was held the position since the company was organized. The company owns and operates the telephone and telegraph wires in Prince Edward, Hastings, Frontenac and several other counties in Eastern Ontario.

Recently there was in Niagara Falls, N.Y., a fierce fire at the power house of the Niagara Falls Power Co. The trouble was caused by some contractors who were blasting under the Buffalo transmission line near the Carborundum Company, who threw a bit of fuse wire over the transmission wire. This caused a short circuit and the blowing out of a fuse in the power-house. The blowing out of the power-house fuse ignited several barrels of lubricating oil that stood in the oil room. The employees of the power-house took things very coolly, and the switchboard tenders never left their stations, although the smoke was so thick that they could hardly see. A still alarm was sent to the fire department and in a short time the fire was under control. The principal damage resulted to the power cables and the insulation, and amounted to about $6,000.

The postoffice authorities recently experimented with mail collections by electric auto-cars. The electric delivery wagon built by the Still Motor Syndicate for the Parker Dye Works was used. The trip extended about 9 miles and was covered in one hour and three minutes, including 2-minute stops at each of the eleven postoffices on the route. The actual running time was not more than thirty-five minutes, just about half the time required by the ordinary mail wagon. The Syndicate has sent in a tender to the department for a mail wagon, capable of running from fifteen to twenty miles an hour, with a carrying capacity of 1,500 pounds.

A special general meeting of the shareholders of the Standard Light and Power Company was held a short time ago in Montreal; W. McLea Walbank, the president, in the chair. The object for which the meeting was called, was to approve of the construction of the new fire-proof station on Chenneville street, now in course of construction, and of ratifying a loan of $75,000 which had been taken up by three of the Ottawa shareholders of the company. Both of these matters were agreed to. The following contracts were awarded: That for engines to the Westinghouse Co., of Pittsburg; for rotary converters to the Canada Electric Company, of Peterboro, and for boilers to Babcock & Wilson.

A patent has been granted to a resident of Vienna, Austria, Anton Othmar, on a composition for arc light carbons, consisting of finely ground wood charcoal or carbon from gas retorts, or both, mixed with finely-ground quartz and diamond dust. The mixture is made up into a dough by incorporating it with a solution of copper salt and with jellied salicylic acid the pencils being moulded from this in the ordinary way and afterwards burned, as usual. The proportion of ingredients by weight are: Carbon, 83 parts; quartz, 7 parts; diamond dust, 10 parts. To 20 parts of the thoroughly mixed powder are added about one quart of a concentrated aqueous solution of copper sulphate and one quart of jellied salicylic acid. The inventor claims that carbons made in this manner burn much more slowly than those in present use.

Mining Matters.

A winding-up order has been issued against the Eastern Townships Chrome Iron Mining and Milling Company.

Leopold Myer, representing a Belgian syndicate, has purchased from T. B. Caldwell, Lanark, Ont., the Calabogie iron mine, for $100,000, paying $10,000 down.

Another attempt will, it is said, be made to utilize the magnetic iron sand of Moise, Bersimis, and other points on the north shore of the St. Lawrence and Gulf.

The announcement has been made that thousands of tons of iron ore have been bought in Newfoundland by Philadelphia capitalists for shipment to that port, to be manufactured into steel.

It is said that the deposits of nickel ore near St. Stephen, N.B., will be thoroughly investigated at once by the English owners, and a perpendicular shaft is to be sunk to the depth of two hundred feet.

The compressor plant reported in our issue of July as being sold to the Rosa Marie Mines on the West Coast of Vancouver Island, was sold and built by the Canadian Rand Drill Co. instead of the Jenckes Machine Co., as reported.

The Graham-McKellar group of iron properties on the Atikokan range, consisting of 16 locations, containing 1,200 acres, and covering 4½ miles of the range, has been bonded to Ronald Hunter, representing American capitalists, for $350,000, for 18 months, so that the parties may test the properties. The sum of $10,000 was paid for this option.

The additional thirty stamps intended for the Dufferin mill at Salmon River, N.S., are in course of erection, the foundations and mortars being already in place. It will be some months yet before the entire complement of sixty stamps are working, as another compound Corliss engine is to be installed to provide the required power.

The Vancouver, B.C., Province, publishes a story to the effect that rich placer fields of gold have been discovered near the upper entrance to the Alberni Canal on the Pacific coast. The distance to that part of the country is about 150 miles by water, from Victoria. It is said that as high as $2 to the pan has been gotten by prospectors.

There have been discovered in the Lake Temagamingue district vast deposits of arsenical iron, carrying gold, which, it is reported, are the largest and richest deposits of this mineral in the world. The ore is in a solid body, it is said, over 1,020 feet long by 310 feet wide. It would take over three generations to take a layer 10 feet deep off the whole tract. The assays show over 47 per cent. of crude arsenic to the ton and $8.20 of gold.

The Foley gold mine in northwestern Ontario has been sold to the Canadian Mines Development Company, Ltd., of London. The Foley Mines Company treasury receives $50,000 cash, and $354,000 in stock, to be divided pro rata among the shareholders. The mine will be started up at once, and the 20 stamp mill will soon again be turning out bullion. The British company is capitalized for 300,000 shares of £1 each. Of these, 150,000 shares go to pay for the property; 75,000 shares, par value $375,000, will be retained unissued in the treasury for a working capital, or to acquire other properties. Still 75,000 more shares have been placed on the market at par in London.

The Ontario Bureau of Mines has arranged for a series of summer mining schools to be held at points in the mining districts of the province, including Parry Sound, Rat Portage and Mine Centre. At each of these places there will be a course of ten days' instruction by lectures and demonstrations by Professors Goodwin and Nicol of the School of Mining, Kingston. The classes will be free to miners, prospectors and others who may desire to take advantage of them. In addition to the regular classes, popular lectures are to be given by Professors Goodwin and Nicol on mining subjects, at other points in the mineral districts. The class of instruction has been already opened at Parry Sound, where there is great activity, stimulated by the recent copper discoveries. So far 72 students are enrolled and the average daily attendance is 55. Two sessions per day are held, each being of two or three hours' duration. Lectures have been given at Marmora, where the Delora gold mine is in splendid shape. Manager Kirkgaarde has improved the plant in many respects, and the stamp mill is showing good returns. The old Arsenic Works are being overhauled and will be in operation in a few weeks.

Marine News.

Two Yukon steamers, the "Nahleen" and "Louise," have been totally consumed by fire at Victoria. The total loss will reach $100,000.

The Richelieu & Ontario Navigation Co. has already filed up receipts in advance of last year, though the season was much later in opening.

From the opening of navigation to the end of July over five million bushels of grain were received at Depot Harbor for the Canada Atlantic Railway.

The Canadian Canoe Co., Peterborough, Ont., reports a very busy season, being still crowded with orders. During the past season in addition to the home trade, this company has shipped several consignments abroad to Great Britain and other countries.

A. T. Wood, M.P.; Wm. Southam, C. E. Doolittle, C. Wilcox, Wm. D. Long, and A. B. McKay, Hamilton, Ont., have applied for the incorporation of the Quebec, Hamilton & Fort William Navigation Company, Limited. The capital stock of the company is $1,000,000. The head office is to be in Hamilton.

Recently the Calvin Company's new steamer "India" had a trial run around the harbor. Her engines worked well, and she answered her steering gear to perfection. Her first trip was to Cleveland, Ohio, to load coal for Fort William, after which she went to Serpent River, Wis., to load iron ore for Deseronto, Ont.

The Red river, which was the principal artery of commerce in Manitoba in the early days, but which has been almost out of use since the advent of railways, is again to be used for traffic purposes. R. A. Lister & Co. have put a steamer on the river to gather up cream for their butter factory at Morris. This is probably the first attempt at utilizing the river for regular traffic purposes south of Winnipeg, since 1882.

The regulations made by the Ontario Government making it imperative that logs cut on Crown timber limits be manufactured in the province, has given the Ontario shipowners a share of the trade in carrying the lumber. The rafting of the logs to which the embargo applies from the Georgian Bay across to points in Michigan has now been stopped, and the Michigan lumbermen are compelled to have their logs sawn here. No vessels were necessary in towing the logs across except tugs, and under the United States coasting law, Canadian vessels could not afterwards help in carrying the manufactured lumber from one American port to another. One result is, that now Canadian vessels are conveying the sawn timber to the numerous ports on the American side.

Personal.

G. H. Garden, of the C.P.R. engineering staff, has gone to take charge of the double tracking of the line between Port Arthur and Winnipeg, a distance of 420 miles.

H. V. Short has been appointed manager of the machinists' tools and engineers' supplies department of the Aikenhead Hardware Co., in succession to A. W. Smith, whose portrait appears in another column of this issue of The Canadian Engineer.

L. B. Stewart, Registrar of the School of Practical Science, Toronto, has reached Dawson, in the Yukon district, where he purposes spending the vacation surveying. A letter posted by him at Dawson on the 3rd July was received by Mrs. Stewart in Orillia on the 25th.

A Canadian, A. W. McCrea, of Merrickville, Ont., was selected from among his class of fifty at the Massachusetts Institute of Technology to represent the architectural department at the closing class ceremonies. He has taken a position with the firm of Cariere & Hastings, prominent architects of New York.

C. A. Woolsey, recently appointed sales agent of the Royal Electric Co., was for some time with the Thompson-Houston Co., as expert, and upon the amalgamation of that company with the General Electric Co. remained with the concern as expert engineer and salesman, with headquarters at New York. Mr. Woolsey has had a wide and varied experience, embracing almost every phase of electrical engineering.

C. J. Pusey, president and manager of the Irondale, Bancroft and Ottawa Railway, died at Peterboro recently from an organic affection of the heart. Mr. Pusey was in railway work all his life. In 1866 he purchased the nucleus of the present I., B. & O. Railway, six miles of complete line, extending eastward from the junction with the Victoria branch of the G.T.R. His object was to extend the line to Brockville, with connections to Ottawa, to give an United States outlet to mining products and to extend the line westward and north to the Georgian Bay. His idea was the establishment of large smelting works in Hastings County. By his own almost entirely unaided exertions, Mr. Pusey secured Ontario and Dominion charters, and in the face of great difficulties finished the scheme and extended his railway eastward by ten-mile sections till now 47 miles are in operation, with five additional miles to be completed this fall. The line has a fairly paying traffic and is doing much in developing the lumber resources of the region it taps, promoting settlement and giving access to promising mining areas abounding in gold, silver, lead, iron, corundum, mica, etc.

Railway Matters.

The last relic of the first epoch of railway engineering in Canada is passing away this month in the form of the tubular bridge on the G.T.R. at St. Anne's. This old bridge, which spans the Ottawa near its junction with the St. Lawrence, is being removed, and a trussed bridge erected in its place. This old bridge is not only the last of the tubular bridges in Canada, but the last on this continent, and its removal is a historic event. The double tracking of the Grand Trunk between Toronto and Montreal is proceeding. A short section of two miles from Trenton to Murray Hill and one of three and a half miles from Sydney to a point east of Trenton, both of which are in progress now, will make the double track complete between the two cities, excepting only a strip of 30 miles running east from Scarboro Junction, on which, however, the traffic is not so heavy as on the rest of the route. A double track is also being made east of Montreal from St. Lambert to St. Bruno. Of the twelve big passenger engines, recently described in this journal, six are now on the service between Montreal and Toronto, and the new train equipments on this part of the Grand Trunk are spoken of in the highest terms by the travelling public.

RAILWAY SUBSIDIES.

The Minister of Railways has proposed the following resolutions: That it is expedient to authorize the Governor-in-Council to grant a subsidy of $3,200 per mile towards the construction of each of the undermentioned lines of railway (not exceeding in any case the number of miles hereinafter respectively stated), which shall not cost more on the average than $15,000 per mile, for the mileage subsidized, and towards the construction of each of the said lines of railway, not exceeding the mileage hereinafter stated, which shall cost more on the average than $15,000 per mile for the mileage subsidized, a further subsidy beyond the sum of said $3,200 per mile of 50 per cent. on so much of the average cost of mileage subsidized as shall be in excess of $15,000 per mile, such subsidy not exceeding on the whole the sum of $6,400 per mile.

Central Ontario Railway Company, for an extension from, at or near either Coe Hill or Rathbun Station on the company's railway, at or near Bancroft, not exceeding 21 miles, in lieu of the subsidy granted by 55-56 Victoria, chapter 2—Re-vote.

Great Northern Railway Company, for a railway between Montcalm and St. Tite Junction on the Lower Laurentine Railway, Quebec, not exceeding 53½ miles, and for a branch from their main line to Shawenegan Falls, Quebec, not exceeding 6½ miles, 53½ miles—Re-vote.

Phillipsburg Railway and Quarry Company, shortage in the extension of their railway from a point on the company's line at or near the end of the subsidized section to the Government Wharf at Phillipsburg, Que., not exceeding 6 6-100 miles—Re-vote.

Strathroy & Western Counties Railway, for a line from Strathroy, Ontario, via Adelaide and Arkona to either Forest, Thedford or Parkhill, not exceeding 24 miles, in lieu of subsidy granted by 57-58 Victoria, chapter 4, partly—Re-vote.

St. John Valley & Riviere du Loup Railway Company, from Fredericton to Woodstock, not exceeding 59 miles—Re-vote.

For a railway from Port Hawkesbury, on the Strait of Canso, Nova Scotia, to St. Peter's, not exceeding 30 miles—Re-vote.

For a railway from Windsor, N.S., to Truro, via Township of Clifton, not exceeding 58 miles—Re-vote.

For a railway from a point at or near Brockford Station, N.S., on the Intercolonial Railway, to Eastville, not exceeding 25 miles—Re-vote.

For a railway from Cross Creek Station, on the Canada Eastern Railway, to Stanley village, N.B., not exceeding six miles—Re-vote.

For a railway from the village of St. Remi to Stottsville,

or some point on the Delaware & Hudson (Grand Trunk), in the parish of St. Valentine, not exceeding 19 miles, of which 12 miles is a re-vote.

For a railway between Pontypool and Bobcaygeon, via Lindsay, Ont., not exceeding 40 miles, 32 miles re-vote.

Pontiac Pacific Junction Railway Company, for a railway from Aylmer to Hull, Que., in lieu of the subsidy granted by 60-61 Victoria, chapter 4, not exceeding nine miles.

Portage Du Fort and Bristol Branch Railway Company, for a branch line on the Pontiac Pacific Junction Railway, at or near the village of Quyon, towards the village of Portage Du Fort, Que., not exceeding 15 miles, in lieu of the subsidy granted by 60-61 Victoria, chapter 4—Re-vote.

Oxford Mountain Railway Company, for a branch from their railway from a point between Lawrenceville and Eastman, to Waterloo, not exceeding 13 miles; 4½ miles re-vote.

Atlantic and Lake Superior, from Coplin to Paspebiac, Que., not exceeding 30 miles.

United Counties, from St. Robert Junction to Sorel, 6½ miles, and from Mount Johnson to St. George station, 1 mile, not exceeding 7½ miles.

For a railway from a point on the Central Railway, County of Lunenburg, N.S., to Liverpool, via Caledonia, or to the village of Caledonia, via Liverpool, or for any part thereof, the whole distance not exceeding 62 miles—Re-vote.

For a railway from Indian Garden, Queen's County, N.S., to Sherbourne, a distance of 35 miles—Re-vote.

The subsidy which the Ontario and Rainy River Railway Company is entitled to receive, under chapter 4, 60-61 Victoria, shall be $6,400 per mile, for the 80 miles provided for in the said Act.

Bay of Quinte Railway Company, for such extension, not exceeding $3,200 per mile, for 10 miles, nor exceeding in the whole $32,000—Re-vote.

Quebec and Lake St. John Railway Company, for 12 miles, from end of their line at Deep Water, on the Chicoutimi branch, to Ha Ha Bay, in lieu of the subsidy granted by chapter 4, of 1894.

For a line of railway from Hawkesbury, Ont., to South Indian, not exceeding 35 miles.

For a railway from Sault Ste. Marie, Ont., towards Michipicoton river and harbor, and to main line of Canadian Pacific Railway, not exceeding 40 miles.

For a branch line from the main line of the Ottawa, Arnprior and Parry Sound Railway, to the town of Parry Sound, Ont., not exceeding five miles.

For a railway from the village of Haliburton, via the village of Whitney, towards the village of Mattawa, Ont., not exceeding 20 miles.

For the extension of the Tilsonburg, Lake Erie and Pacific Railway, from Tilsonburg to Ingersoll or Woodstock, Ont., not exceeding 28 miles.

To the South Shore Railway Company, from Sorel Junction, along the south shore of Lothiniere, Que., a distance not exceeding 82 miles.

Massawippi Valley Railway Company, for an extension to Stanstead Plain, Que., not exceeding 2½ miles.

For a railway from Port Hawesbury, on the Strait of Canso, to Caribou Cove, N.S., a distance of 10 miles.

For a railway from Fort Frances, Ont., westerly to a point at or near the mouth of Rainy River, a distance not exceeding 70 miles.

To the General Railway Company, of New Brunswick, for an extension from Newcastle coal fields to Gibson, N.B., not exceeding 30 miles.

Canadian Northern Railway Company, for a railway from a point on the present line of the Winnipeg Great Northern Railway, north of Swan River, to Prince Albert, N.W.T., not exceeding 100 miles.

For a railway from some point near Arthur Station to a point south of Moose Mountain, Manitoba, not exceeding 50 miles.

For a railway from Sunnybrae to County Harbor, and from a point at or near County Harbor cross roads to Guysboro, N.S., to make up deficiency in mileage between points mentioned, additional mileage not exceeding 15 miles.

For a railway from Port Clyde to Lockport, N.S., not exceeding 20 miles.

For a railway from a point on the Intercolonial Railway at or near Halifax to a point on the Central Railway in the County of Lunenburg, not exceeding 20 miles.

For a railway from Labelle, in the Province of Quebec, in a north-westerly direction to Nominingue via Notre Dame Del Annonciation, a distance not exceeding 22 miles.

For a railway from Owen Sound to Meaford, not exceeding 21 miles.

Ottawa and Gatineau Valley Railway Company, for their line of railway in and through the city of Hull, Que., not exceeding four miles.

Western Alberta Railway Company, from a point on the United States boundary west of Range 27, north-westerly towards Anthracite, in the district of Alberta, not exceeding 50 miles.

Edmonton, Yukon and Pacific Railway Company, from South Edmonton, N.W.T., to North Edmonton, and thence westerly towards the Yellow Head Pass, a distance not exceeding 50 miles.

Restigouche and Western Railway Company, in addition to the 20 miles granted, and in continuation towards the St. John river, a further distance, not exceeding 15 miles, and towards Campbellton, a distance of 12 miles in all, not exceeding 27 miles.

For a railway in extension of the St. Francis branch of the Temiscouata Railway, to the mouth of the St. Francis river, a distance not exceeding three miles.

Canada Eastern Railway Company, from Nelson, N.B., to connect with the main line into Chatham, 2¼ miles.

Bay of Quinte Railway Company, for an extension in a westerly direction from Deseronto for a distance not exceeding two miles; also for an extension from Tweed in a northerly direction not exceeding five miles, in all seven miles.

Ontario, Belmont and Northern Railway Company, for an extension from iron mines in a north-westerly direction a distance not exceeding five miles, and also for an extension railway southerly from the present southern terminus to the Central Ontario Junction of the Canadian Pacific Railway, a distance not exceeding two miles, but the last-mentioned aid for the said two miles of railway shall not be granted in case the Railway Committee of the Privy Council finds that adequate running powers on fair terms cannot be secured to the company over that portion of the line of the Central Ontario Railway between the present southerly end of the Ontario, Belmont and Northern Railway and the Canadian Pacific Railway Company's line at Central Ontario Junction.

For a line of railway from a point on the Pembroke Southern Railway, at or near Golden Lake, Ontario, towards a point on the Irondale, Bancroft and Ottawa Railway, at or near Bancroft, not exceeding 20 miles.

(To be continued).

WANTED—Young man familiar with installing and repairing electric recording meters. Give particulars of experience. Only hustlers and first-class penmen need apply. Advancement if satisfactory. Address "WATT," Canadian Engineer, Montreal.

WANTED—A First-class Mining Foreman, who has had experience in Galena, Zinc and Silver Mining. Send references and rate of wages expected to P. W. RESSEMAN, 31 Central Chambers, Ottawa, Ont.

FOR SALE

A good Water Power, 500 horse, situated one-half mile from railway, every facility for making siding to power. Address
J. D. THEUNISSON, Cookshire, Que.

Canoes & Boats

For Prospecting

All Kinds of pleasure Canoes and Boats

WRITE FOR CATALOGUE "A"

H. B. RYE, PETERBOROUGH ONT.

The Canadian Engineer

VOL. VII.—No. 5. TORONTO AND MONTREAL, SEPTEMBER, 1899. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain nd foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR, R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE.

Toronto Telephone, 1392. Montreal Telephone, 2589.

UNITED STATES AGENT:
H. E. BURNETTE, Cor. Fourth and Locust Sts., Philadelphia.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Asphalt Block, The	146
Bicycle Combination, the Canadian	140
Canadian Water Power and its Electrical Product in Relation to the Undeveloped Resources of the Dominion	124
"Compressed Air" Fizzle, That	127
Cement Industry, The	127
Drill Grinder, The Yankee	141
Draft, The Influence of Mechanical, upon the Ultimate Efficiency of Steam Boilers	138
Electric Flashes	142
Firemen's Association, Ontario Volunteers	136
Fires of the Month	146
Filtration, Sand, of Public Water Supplies	148
Grand Trunk, Portland Terminus of	127
Industrial Notes	141
Isle of Man Tramways	137
Killey, The Late J. H.	135
Literary Notes	140
Lachine Rapids Works, Proposed Improvement at	123
Mining Matters	144
Marine News	145
Metal Imports from Great Britain	148
Mineral and Metal Productions in 1898, United States	135
Personal	145
Railway Engineering	141
Railway System, Revolution of the Present by the Advent of the Elevated Electric Railway	121
Railway Subsidies	137
Railway Matters	144
Stationary Engineers, Tenth Annual Convention, Canadian Association of	128
Vise, Pipe, Hough's Extra Heavy Combination	141

For THE CANADIAN ENGINEER.

REVOLUTION OF THE PRESENT RAILWAY SYSTEM BY THE ADVENT OF THE ELEVATED ELECTRIC RAILWAY.

BY A. DAVIS, CONSULTING ENGINEER, MONTREAL.

About sixty years ago England gave birth to the steam surface railway, and inaugurated the present system, and now it is about to inaugurate the railway of the future. England waits the proper time before adopting any new invention, and spending money uselessly. Her people will generally make sure of the new undertaking, and will then wait to see if anything better will turn up that can replace what is already in operation with lasting advantage, as they have done in the present case. They have waited sixty years for new developments in railway systems, but in reality there has been comparatively no change in the last fifty years, although it must be admitted that the speed has been increased on passenger trains during the past forty years about twenty miles per hour. The changes in themselves have not been elementary, but consist only in making the cars more comfortable for the traveling public. The weight and size of the railway rolling stock has been increased greatly for facility and economy in operating railways of America, but not so rapidly in England. In this fact the prudence of the English people again shows itself. They correctly think there is a limit, and have stopped increasing the weight of their rolling stock, and have turned their attention to how it would be best to meet the emergency which demands greater facilities and quicker means of transit, with more absolute safety.

Our American railway managers as yet see no limit, and they are increasing the size of the carrying capacity of their rolling stock. From ten to thirty-ton car engines are also increased in power and corresponding weight; all this with one idea in view, and that to reduce the cost of operation of their line. Of course, this looks well calculated to give the company the desired result. The main substance in this decision is the great saving of labor; in fact the managers will tell the directors of their companies that in place of two trains being required to move a given quantity of freight, one train with one staff will do the work, so that 50 per cent. is saved on engine drivers, firemen, conductors, and brakesmen, and 50 per cent. on locomotives. This is for freight trains only, as the number of passenger trains remains the same. When this report is made at a directors' meeting, there are smiles and happiness all round. They are also shown the great change made by steamship companies of replacing the small steamers with those of four times the carrying capacity. In this, no doubt, a great saving is obtained without so great an outlay. A large expensive steamship must be paid for to replace, say four of the smaller ones, but it cannot be compared with the change that follows in the railways increasing the carrying capacity of their rolling stock proportionately. The changing of the small steamers to the large ones means one steamer to each four, hence one crew, one set of officers, one set of engines and boilers, in fact, one complete ship at sea, one steamer berth at harbor, all in place of four. It is true that the crew will number a few more men than on a small steamer, and the consumption of coal is greater, but not nearly as much coal will be used as on four smaller ones. The risk of accidents at sea is lessened by 75 per cent., therefore the saving must be very great. Also, the steamship company does not lose the small steamers, as steamers of almost any size can be put into service at various classes of carrying on the sea, so that reduces the expense to a large extent, and the extra expense ends there.

Now let us see how differently the change affects the railway companies when the carrying capacity is proportionately changed. In place of one ship, thousands of new cars are required, and in place of one engine, hundreds of new locomotives are needed. This is not all. The very moment this new heavy rolling stock is ready to be put into operation, new and heavier rails, new and larger ties, and new and stronger bridges are required for the whole line, as well as new turntables for locomotives; the road-beds require additional ballast, and in many cases new engine-houses are needed. In the repairing shops additional machines to

take in the larger parts of the larger locomotives will be necessary; in fact the companies may look to the expense of a new railway, less the right of way and road-bed, to meet the change, all in addition to almost the total loss of the rolling stock, rails, bridges, etc., as all of it can only be scrapped at best, as when the change on a few of the trunk lines takes place, all other lines will have to follow or they could not compete, so that old rolling stock will be discarded, hence the great loss; so that when all the cost of this change has been correctly figured it will change the net receipts after the interest has been paid on many milions of outlay. Again, the maintenance of the new heavy rolling stock, and the wear and tear of the rails, bridges, road-bed, and rolling stock itself, will be much greater. The same number of bearings will have greater friction, hence a large increase of lubrication and wearing material. The road-bed and bridges will suffer in proportion; the extra friction, which will have to be applied to the wheels to stop these heavy trains, and to moderate their speed on down grades, and likewise on the pull-up grade—the extra adhesion required to the rails—all this will cause quicker destruction, and again the accidents.

While it is strange to say that the system of steam surface railways has been in existence about sixty years, there have been comparatively no improvements outside of the enlarging of the cars and locomotives, and making them stronger and more comfortable for travellers, and indeed following the extravagant luxury of hotels, etc. Outside of this the system is comparatively the same. The speed of passenger trains has been increased about twenty miles per hour in forty years. The cost of transit for persons and freight remains about the same on the all around average. Regarding accidents: While various devices have been applied, the only one which has been of any consequence in minimizing the number of accidents to the employees is the automatic coupler, which is still far from perfection. The number of accidents on railways of all kinds and under all circumstances have been continually on the increase, and the cause of this is that the competition of railways has become greater as new railways have been built continually, and railway managers have had but one object in view, and that is, cheapness of operation of their line; so that cheap material and construction has been used; anything that would call for a little additional expense for the minimizing of accidents not being entertained. The crowding of railways into large cities has become so congested that accidents are almost of daily occurrence. Now, what is to be done to insure safety of travel on railways—quicker transit?

The elevated electrical railway is no doubt the rail way of the future, and as England gave birth to the first system of steam railways, that country is about to give birth to the coming system. They are about to build an elevated railway in a district full of railways, that is, between Liverpool and Manchester. This proves that they feel sure that the new mode of transit will and must be this system, that will gradually take the place of the surface railways, both for passengers and express freight. First, there is the surety that an elevated railway can be made so as to insure positive safety from all accidents whatever, running at 100 miles per hour, or more, because being elevated no contact with moving or other objects on the ground surface will be liable, no accidents from floods or washouts, landslides, or misplaced switches will occur, nor from broken wheels or rails, or any kind of collisions resulting from the mal-intent of anyone putting anything on the track. In the case of trains following each other, the connections would be cut from the power of the following train by the operations of the first train, which might be stopped from any unforeseen emergency; so that the following train would have no propelling power in case of the necessity to stop the first train, and the electric signal would automatically strike the bell on the train that followed. As to falling off the track, that would be prevented by a gab grip that would follow the T of the top cord of the truss, so that it would be impossible for the wheels to mount the rail or get the body of the car lower than the top cord of the girder, only four inches distant. The side of the car is also protected by the sides of the girders, which have a flat, smooth plate running on both sides, which would come in contact with rollers fitted on the sides of each car. There would be no snow to ever block the line or cause any expense or accidents; no grades of any consequence, so that the uniform speed would be constant; no short curves to create danger or extra friction, the track would always be uniform and the cars would always run very smoothly; no dust and cinders or grit to cut up bearings and the machinery, thus all axles could be made to run smoothly in ball bearings with comparatively little lubricant, and the cars would be free from smoke and dirt of any kind.

One can fancy the comfort to travel in cars that are perfectly safe, running smoothly, with good and clean ventilation, also the enjoyment of looking over all the surrounding country as a good panorama. The electric single rail projected by F. B. Behr, for the elevated railway to be built from Liverpool to Manchester, is not the style of railway that can be practically successful. With the single rail system, the one wheel would not be sufficient to attain a very high rate of speed, as the one rail system would cause the wheels to slip, the extra friction would be a great detriment, which would be caused by oscillation that must take place from the uneven loading of cars, wind, etc. While the new system invented is perfectly free from any interference from the above causes, and the railway itself can be built much cheaper, lighter and safer, the cars remain the same type as the surface cars are at present. Of course the cost of building an elevated railway would be greater on the first outlay than a surface railway, on account of the height it must be made at some places, such as crossing rivers, towns, etc. This will require pillars or piers to be made very heavy and strong for perfect safety. But on the other hand the mileage can be reduced on the average at least 25 to 30 per cent. There would be comparatively no right of way to pay for, as only the pillars will take up any valuable space in the country, and very little anywhere. No embankments, no ditches, water culverts, stone or brick arches for roadways, no tunnels to be cut through mountains, no fences, no men to guard level crossings or on the track, no accidents to trains on crossings, and no expense caused by the killing of people or beasts on crossings, and no ballast required, which with its maintenance is a very large item.

After all the above items and the constant maintenance of the same is carefully summed up, it will go

very largely to make up the difference in first cost. Then comes the difference in cost of operation of the two systems. One, the electric elevated, comparatively no dead weight of locomotives, and only the motor car, and less than half the dead weight of the cars to be hauled over the line; the staff of engine drivers and firemen with all the assisting staff at engine houses reduced; no haulage of coal and water over the line; no water stations, water pipes, and water pumping engines; coal stations and the staff—all will be reduced to three power stations per 100 miles, where its boilers, engines, and machinery are stationary; no cost for its haulage; also the engines, as already stated, use up the line with their heavy weight; all the heavy gear wears away much faster. No damage from fire caused from sparks of locomotives, and no more burning up of trains and passengers when trains are run off the track and down embankments or in collisions. Also by removing the passenger trains from the surface railways will give much more facilities to freight trains, which will also prevent many accidents and delay to the freight in transit. Now this is only a question of the first outlay, which cannot help but double itself in a short time, and be a blessing to the human race in its advance with the commercial progress of each year. I am quite sure that my system of elevated railway will accomplish all I claim here, and even more when all the details are fully considered.

Now, as to its possibility of revenue sufficient to warrant the outlay. Say that such a line should be built from New York to Chicago. The present time consumed to make that run is about 35 hours, while the time would be only 7 hours by the elevated, the distance being reduced to 700 miles, and the train running at 100 miles an hour, would be 7 hours in place of 35 hours, or 14 hours in place of 70 for the round trip; outside of the person arriving by the elevated perfectly rested and ready for business, in place of requiring six or eight hours to rest after one has travelled to Chicago by the present system. As to number of passengers, they could afford to go a distance of 300 or 400 miles, to start for Chicago from New York. Say passengers from Quebec, Montreal, or Boston, could reach New York in one night and take the elevated, they would still make the journey in about half of the present time, and the same in the vicinity of Chicago. An elevated line built now between these two points would be only a beginning of the new system, which would not only be a great rate of interest on the outlay, but a general benefit to the travelling human race.

PROPOSED IMPROVEMENT AT LACHINE RAPIDS WORKS.

The Lachine Rapids Hydraulic & Land Company is undertaking a considerable amount of work this year, at the Lachine Rapids, the experience of the past two winters having exhibited the action of the water and ice both at the head and tail races. Last winter, for instance, the water in the tail race was abnormally nigh, higher, it is said, than it has been for thirty or forty years, and while the head race was not materially affected, so far as the supply of water was concerned in the river, yet the ice entered the intake and would not permit of sufficient quantity of water entering, without drawing down, so that they had to meet the worst conditions possible, namely, the highest back water and low head water inside the intake. Various schemes have from time to time been suggested for preventing the entrance of this ice into the head race, principally by means of large and deep booms.

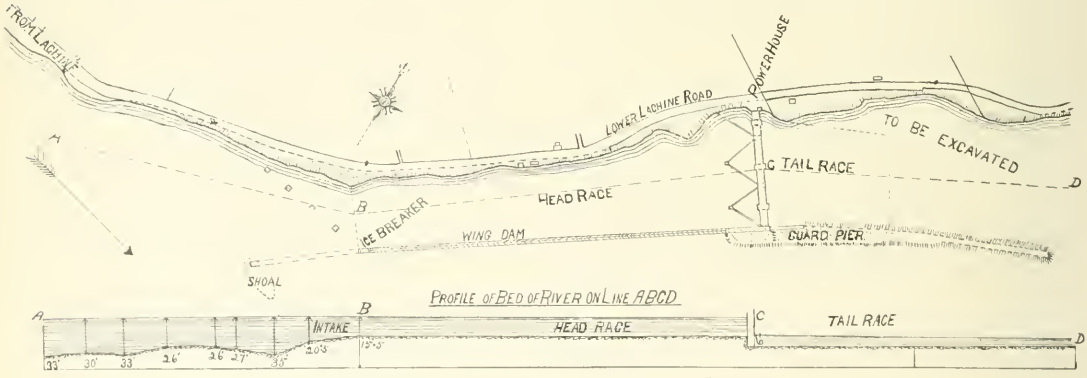
W. McLea Walbank, the original promoter of the company, and one of its engineers, was decidedly against this principle, inasmuch as he contended it would be almost impossible to construct a boom that could be held there, and in addition to which, the current is so strong that even a deep boom would be of little or no use.

After the ice went out of the river this spring, Mr. Walbank had his assistants carefully sound the river above the intake, and submitted to the directors a scheme for the improvement of the works and suggested consultation with outside engineers. The result of the soundings taken in the river showed that there was a deep channel connecting with the main channels of the river at McDonald's Point, as shown on the accompanying plan. This deep channel continued down to almost in front of ice breaker, where the water was turned almost at right angles into the river. The result was that the current had a tendency to draw the ice from the river opposite McDonald's Point, following the deep channel and discharging between the shoal and ice breaker, and naturally depositing ice at the mouth of the intake, which gradually filled up and impeded the flow of water. The channel between this shoal and the ice breaker is somewhat over 20 feet deep. The plan proposed by Mr. Walbank was as follows: Raise the existing wing dam the level of the water in the head race during the month of December, so that there would be absolutely no water running over during winter; also extending the wing dam the same level about 1,000 feet further up the river. The result of this would be to make the intake, in place of 525 feet wide, nearly 2,000 feet wide, and the water in place of being 12 feet deep, would be between 30 and 40 feet deep. The current at present there would be destroyed and the river freeze over. The main direction of the river current would then be at an angle with the head race, rather than leading into it, as at present. For the improvement of the tail race, he suggested the raising of the guard pier about 4 feet, and the extending the same down stream, a distance of about 1,000 feet, and excavating of a deep channel between the guard pier and main shore, and removing the shoals. The object of the extension of the pier was to deflect the ice into the stream. The river below the rapids freezes over in some winters, and forms natural dams in the river itself, which raises the water very considerably, last winter coming one foot over the present guard pier. The object of raising it was to prevent a re-occurrence of this and to allow the tail water to take the discharge of the wheels only, without being influenced by the water in the river, except the natural backing up which occurs every year to a greater or less extent, and which is allowed for in the original plans. In addition to the foregoing, a glance pier from McDonald's Point, running completely down stream, was suggested.

T. C. Keefer, an engineer of very high standing in hydraulic matters, and well-known to our readers, was consulted by the company, and he has reported to the Lachine Rapids Company, endorsing the scheme

here outlined. He says, in his report: "The closing of this cross river channel will not only send the river current and its ice above and outside of, instead of below and inside the shoal, and move it at least one thousand feet from the comparatively narrow and shallow entrance to your head race, but it will destroy the current leading to its mouth. It will move the entrance from its present position to a line opposite the head of the shoal, where the water is both wider and deeper, so that it will be three times greater in area than at present. Above McDonald's Point, the shore line trends to the right, and its course, if produced down stream, would strike the shoal about where the extended wing dam would have its ice breaker. When this extension is made, the shore line of river current, instead of rounding McDonald's Point and flowing in shore, will flow nearly in a straight line toward the new ice breaker and outside the shoal. Your entrance basin, instead of being five hundred feet wide and twelve feet deep, will be about four times as wide and three times as deep. Its current will, even when all your wheels are going, have little attraction for the frazil compared with that of the St. Lawrence, where it has a fall of twelve inches per mile. At present you have no entrance basin, but feed the bordage ice. The extension of the wing dam will have the effect of raising the level of the head race (thus increasing the water power), but to what extent it is impossible to say, probably not exceeding six inches. The level of your wing dam should be such that no water can flow over it when ice is running in the river, especially frazil, because the draught caused by this overflow might exceed that caused by your wheels and bring in too much ice. When the cross river channel is closed, I do not think there would be any tendency of 'field' ice to enter the new basin for reason stated above, and then the level of the wing dam could be governed by the frazil level, as that will be after the extension."

Mr. Keefer further endorses a separation of the tail race from the river and the deepening of its channel, but was of opinion that the glance pier was unnecessary. The company has decided to immediately carry out these works, and the contract has been awarded to W. J. Poupore, M.P., Ottawa, as mentioned in the last issue of the Canadian Engineer, and whose firm are now making good progress in the work, the contract calling for its completion by December 1st. In addition to the foregoing, the Lachine Rapids Co. will protect its



Improvements in Lachine Rapids and Hydraulic Company.

direct from one of the deep channels of the river which brings its frazil to your doors, but with the proposed extension you will have a deep basin covering over two acres of surface, which will freeze over nearly to the line between McDonald's Point and the shoal on which your new ice breaker will be planted. This bordage ice on its river edge will be thickened by wind and wave, and act as a boom to exclude passing frazil. It will not entirely exclude it, for when the river above is covered at its wider part, and its ice is crowded into the narrower width, as it approaches the rapids the frazil will flow deeper and some of it will be forced under the bordage ice and out of the influence of the river current, when it immediately rises to the under side of the bordage, is frozen to it and thus thickens the ice boom. When the full draught of all your wheels is in force, some of the frazil elbowed out of the river may descend farther down, but will be arrested by its friction against the surface ice and laid up for the winter in the new basin before it can reach your head race. This ice boom will probably take a curved form chiefly toward the lower end, and more frazil be forced under on the side toward the wing dam than near McDonald's Point, leaving an inshore unobstructed channel under patrons by installing an auxiliary steam plant, which will place the works beyond any question of being able to supply their demands.

CANADIAN WATER POWER AND ITS ELECTRICAL PRODUCT IN RELATION TO THE UNDEVELOPED RESOURCES OF THE DOMINION.*

(Concluded from last issue).

In order to present more fully the recently enhanced value of our Canadian water power, some reference is necessary to certain properties of electricity, the power which has happily been described as "the most romantic form of energy," by Wm. Henry Preece, C.B.F.R.S., in his recent address as president of the Institution of Civil Engineers. Inasmuch as the cost of production of electrical energy depends upon continuity of output, water power must be the ideal one for this purpose, at least until some cheaper power is discovered. In some places where steam is now used for electric light, other industries have been added to secure the more continuous use of the power in daylight hours. The only quality in which any deficiency has been exhibited by electricity is for lighthouse purposes,

*Presidential Address read before the Society, May 23rd, 1899, by Thos. C Keefer, C.M.G., President of the Royal Society of Canada

a lesser power of penetration in fogs, in which respect it is inferior to oil or gas; but even this has in the present year been more than compensated for by the successful application of "wireless telegraphy," by which, in any weather, communication between the ship and the shore can be established. The shores of the St. Lawrence from the Atlantic to the lakes are lined with water power which can be used to light, in fair, or protect, in foul weather, the passing vessel; to ring the bell or blow the horn. When water is applied for light and power purposes, its economy is always the important factor; but it is chiefly to its value for electro-chemical industries that Canada will look to reap the greatest benefits, because in these it is not merely a question of competition of power producers, but one in which intense electricity has the monopoly, and in the case of some of them, as in the production of aluminium, calcium carbide, carborundum, etc., their existence depends upon ample supplies of an intense electric current, for the generation of which abundant and cheap water power is indispensable.

Touching electro metallurgical processes, Mr. Preece says: "Every electrolyte requires a certain voltage to overcome the affinity between its atoms, and then the mass decomposed, per minute or per hour, depends solely upon the current passing. The process is a cheap one and has become general. Three electrical h.p., continuously applied, deposits 10 lbs. of pure copper every hour, from copper sulphates, at the cost of one penny. All the copper used for telegraphy is thus obtained. Zinc in a very pure form is extracted, electrolytically, from chloride of zinc produced from zinc blende, in large quantities. Caustic soda and chlorine are produced by similar means from common salt. The passage of electricity through certain gases is accompanied by their dissociation, and by the generation of intense heat. Hence the arc furnace. Aluminium is thus obtained from cryolite and bauxite. Phosphate is also separated from apatite and other mineral phosphates. Calcium carbide, obtained in the same way, is becoming an important industry. Electrical energy can be generated on a coal field, where coal, of good calorific value, is raised at a cost of three shillings per ton, cheaper than by a water fall, even at Niagara."

Eastern and Western Canadian coal fields are separated by thousands of miles, but water power is abundant throughout nearly all this coalless region. Our Western coal fields are vast and their market at present limited. If coal can be raised cheaply enough and the raw material for the work be discovered in the neighborhood, they may give rise to electro-chemical and electro-metallurgical industries without the intervention of water power. The commercial production of calcic carbide (acetylene gas) by electrolysis, is the discovery of T. L. Wilson (a grandson of the late Hon. J. M. Wilson, of Saltfleet, Ontario), who has established works on the water powers of the Welland Canal and has shipped this product all round the world. The electric production, commercially, of caustic soda and chlorine, is under the patent of Ernest A. Lesueur, son of the Secretary of the General Post Office Department, Ottawa. This manufacture is now being carried on by a Boston company at a New England water power.

There is another field nearly as widespread as our water power in which electricity is destined to play a most important role, and this is mining, which is now spreading over the Dominion with the same rapidity as the utilization of our forests for pulp and paper purposes. Over this area minerals have been discovered and in many cases tested and successfully worked, and from recent results we appear to be on the threshold of remarkable developments in this direction, especially as so small a portion of so great an area has been prospected sufficiently for mining purposes. For power purposes alone, electricity is invaluable in mines, and its multifarious uses (as enumerated by Mr. Preece) are "for moving trams and for working hoists; it lights up and ventilates the galleries, and, by pumping, keeps them free from water. It operates the drills, picks, stamps, crushers, compressors, and all kinds of machinery. The modern type of induction motor, having neither brushes nor sliding contacts, is free from sparks and free from dust. Electric energy is safe, clean, convenient, cheap, and produces neither refuse nor side products." The Canadian mining districts are well supplied with water power, and all the wonderful effects of electricity are available for us upon a larger and more economical scale than elsewhere. In connection with this abundance of water power, and from the fact that a large proportion is at present situated remote from present railways and present settlements, the question of profitable limit of electrical transmission is most important—if indeed, it be now possible to put a limit on anything connected with electricity, with or without the aid of a wire. If, as reported, Lord Kelvin has placed the profitable limit at 300 miles, this is sufficient to utilize the greater part of the water power upon the two watersheds north of the St. Lawrence river. Professor Elihu Thomson says: "Up to the present time it was practicable to transmit high pressure currents a distance of 83 miles, using a pressure of 50,000 volts. If a voltage higher than that were used, the electricity would escape from the wires into the air in the form of small luminous blue flames." As showing how far we are yet behind nature, Professor Thomson says the estimated voltage from a lightning discharge ranges from twenty to fifty million volts. Wherever the raw material for electro-chemical, electro-metallurgical, or other industries, affords sufficient inducement, and the water power is at hand, the forest will be penetrated much more rapidly than heretofore, and settlements advanced in new directions. What can be done in this direction is best illustrated by the development of a single industry in the wilds of Minnesota, north of Lake Superior, and adjoining Canadian territory. Over four hundred miles of standard gauge railways have been built, through what was a trackless wilderness in 1885, to reach iron ore beds, the ore from which is shipped to Lake Erie and thence again railroaded 200 miles into Pennsylvania. This one business has, in mines, railways, docks and fleets of steamers, required an investment of $250,000,000, and has led to as low a rate, by water, as 1 cent per bushel for wheat between Chicago and Buffalo, and 20 cents per ton for coal from Lake Erie to Duluth, nearly 1,000 miles. One-half of the charcoal iron, and more than half of the pig iron made in the United States, is smelted from Lake Superior ore.

The substitution of electricity for steam as the motive power for railways on many roads is regarded as inevitable sooner or later. It has already taken place

as regards suburban railways, notably in the case of the Charlevoix road and Hull and Aylmer railway, where water is doing the work which has heretofore been done by coal. The chief obstacles to an early change on the larger roads are the hundreds of millions invested in locomotives, and the very large outlay required to equip existing steam roads with the electric system. The principal inducement would be the passenger service, owing to the increased speed possible—it being confidently stated that, with electricity, a speed considerably over one hundred miles per hour could be attained. Moreover, there would be the entire abolition of the poisonous smoke which drops upon the Pullman in preference to any coach ahead of it. While the conversion of trunk lines would be attended with a cost which is for the present prohibitory, this objection does not apply to new lines which may be worked independently, or in connection with electric ones. When the time arrives for such railways, water power will have a field of usefulness of which we can at present form little conception. Water wheels and wires would displace the coal docks, the coal laden vessels, the huge coal yards, and the trains required for distributing their contents over hundreds of miles of lines. An interior line connecting Lake St. John, on the Saguenay, with Lake Temiscamingue, on the Ottawa, which could ultimately be extended, via Missanabi, Nepigon, and Lac Seul to the Saskatchewan, would be a colonization road, removed from the frontier—one which could be worked possibly altogether by water power, and would open a virgin tract in which electro-chemical and electro-metallurgical industries might arise, as well as those connected with the products of the forests and the mine.

The more extended use of our water power, in the immediate future, for manufacturing and mining purposes, especially for the electro-chemical and metallurgical productions, naturally leads to the consideration of the character of the output, especially with regard to markets, and transportation problems generally. Transportation, next to production, is the most important commercial question to a country of vast distances and low-priced products, affording great tonnage, such as we produce; and for which we have expended hundreds of millions in canals and railways, harbors, light-houses and steamers, a sum disproportioned to our realized wealth, as it certainly is to our population. But, *"noblesse oblige,"* we possess a vast estate, are compelled to develop it—and await results. The question of transportation determines, to a great extent, the existence, or otherwise, of a possible industry, and enhances or diminishes the value of every article of export just in proportion to its efficiency and economy. On the other hand, where transportation is necessarily expensive, cheap production may maintain an industry—and here is where our abundant water power may come in. The geographical position of Canada in relation to the commercial centre of gravity of the North American continent is at least noteworthy. This centre is very near Lake Erie. From the western end of this lake the water route to the Atlantic at the Straits of Belle Isle follows the general direction of a great circle which cuts the commercial heart of Europe, and is therefore upon the shortest route, or "air line." Our two peninsulas, Sarnia-Detroit and Sault Ste Marie, which are the railway gates of the lake region, afford the most direct routes to the Atlantic for all the North-Western States, and are traversed by the trunk lines of railway. From Lake Erie water communication on the largest scale extends through Lake Huron to the extremities of Lakes Michigan and Superior. One-third of the population of the United States are dependent upon the Great Lakes, largely as to exports and imports, and wholly as to rates—which are fixed by the water for the rail routes. One-half of the population of the United States is found within a radius of 400 miles from Cleveland, a Lake Erie port claimed to be second only to the Clyde, as a shipbuilding one, and also the largest iron ore market in the world. The paper and pulp industry, as well as some of the electro-chemical and metallurgical ones (to the present list of which many additions may be made), are distinguished by the large tonnage produced, the output of several pulp mills exceeding one hundred tons per day. For this the St. Lawrence is the natural route for exportation, and to it this heavy tonnage is of the greatest importance as a means of attracting "tramps," as well as liners during the open season. Increase of sea tonnage into the St. Lawrence is essential to our inland commerce; by it only can sufficient west-bound freights be secured to attract a proper share of the commerce of the lakes, after all has been done to give to the latter quick despatch at Montreal or Quebec. There is probably no place in the world where inland transportation is carried on with greater expedition and economy than in the valley of the St. Lawrence. This is due to the character of the inland navigation, unequalled elsewhere, and to the influence which this exerts upon the railways competing with it; and also, because the valley of the St. Lawrence is not only the greatest highway for agricultural products, but of mineral ones, as well as of the products of the forest and the fisheries. More than half of the iron ore produced in the United States is mined around Lake Superior. Into this lake an increasing number of railways are pouring the produce of the vast wheat fields between it and the Rocky Mountains, and thus placing this grain within a thousand miles of Montreal, which is the nearest seaport, by hundreds of miles, and the only one which can be reached by vessels capable of navigating the lakes. Wheat grown in the foot hills of the Canadian Rockies has already reached Lake Superior by an all rail haul of 1,500 miles, a distance considered prohibitory in the early days of railways, as one which would absorb the whole value in the cost of carriage. The lateness of harvest in our North-West, and the early closing of navigation in the St. Lawrence, will soon over tax all our means of transport, both water and rail, during the interval between September and December. The Welland and St. Lawrence canals and the portage railways between Montreal and Lake Huron constitute the Canadian routes, and much, which cannot arrive by water in time for export, will be stored up at nearest lake ports for winter railway carriage to tide water warehouses on the St. Lawrence, for export at Atlantic ports—or for conversion into flour at Ontario and Quebec water powers. This accumulating tonnage from our Western plains and our Eastern forests must call for a proportionate extension of export facilities which should attract tonnage to the St. Lawrence. Already Montreal has eighteen regular lines of

steamers to transatlantic ports, exclusive of tramps. New York alone of the Atlantic ports exceeds this in number. Montreal has five regular lines to Liverpool and the same number to London, two lines to Glasgow, and two to Hamburg, and one each to Bristol, Manchester, Belfast and Antwerp. Baltimore has twelve regular lines of steamships to Europe, Boston nine, and Philadelphia eight. No doubt all these Atlantic lines exceed Montreal in number and tonnage of vessels, as well as in cargo carried. They have twelve months' navigation against seven for the St. Lawrence. The real significance of Montreal's eighteen regular lines of steamships is the demonstration that, in spite of climatic drawbacks, or inferiority in other respects, the St. Lawrence is the route towards which northern exports will gravitate during its open season.

PORTLAND TERMINUS OF THE GRAND TRUNK.

From Chicago on the west, to Portland on the east, change and improvement everywhere meet the eye of the traveller on the Grand Trunk Railway System. In all these changes nothing has been done for mere display or whim, but in every case money has been spent to give increased comfort and safety to passengers or to afford increased facilities for transportation of freight. An instance of the latter may be cited at Portland, where every provision is being made for the winter traffic, which the company will need to provide for at this terminus. Nature has marked out Portland as one of the great sea-ports of the United States in the future. Possessing a wide and deep harbor, well protected from storms by its archipelago of rock-ribbed islands across Casco Bay, of which Portland Bay is an arm, it is not only a safe winter port, but is so guarded by islands and capes as to be easily made a station of immense strength in time of war. Along this harbor the Grand Trunk owns a sea front of nearly a mile, and during the past two years the present management, foreseeing the needs of the sea-borne traffic of the port, have prepared to provide what the steamship companies are even now demanding, for arrangements are concluded which will make Portland the winter port of call of steamship lines, enough to give it practically a daily service to Europe. These contracts include a weekly boat each by the Allan and Dominion lines to Liverpool, a weekly boat to London direct by the Thompson line, fortnightly boats to Glasgow by the Allan and Donaldson lines each, fortnightly boats to Bristol by the Elder-Dempster line, to Hamburg by the Hamburg-American line, while there are reports of a fortnightly service to Antwerp by the Leyland line, and to Manchester by the Manchester line, though the last two proposals have not yet taken shape. To meet this traffic, which will be inaugurated in November, the Grand Trunk recently joined hands with some Portland capitalists in building a second grain elevator, the new one having a capacity of a million bushels, and being provided with three conveyors running direct to their own wharves, so that three or more steamers can take in grain at the same time. Ten cars can unload grain at one time in this elevator, which is provided with all the latest machinery for quick work, being able to deliver 30,000 bushels per hour. While the grain trade has been well looked to, other merchandise is amply provided for by four new freight sheds, each about 500 feet long and 100 feet to 120 feet wide. This gives six sheds alongside of which tracks are laid, and from which seven or eight ships can load at a time. In fact, ten vessels have been loading or discharging cargo at a time at the G.T.R. wharves, which can accommodate vessels of 500 feet length. There are also two coal wharves owned by the company, having ample capacity for present needs. Last year new tracks were laid in the company's yards to accommodate 1,500 cars, and this has been followed by the erection of new stock yards to accommodate the growing export cattle trade. The city of Portland, which has now a population of about 60,000, including the suburbs of Deering and South Portland, and which has an active board of trade, with a membership of over 300, appears to be fully awake to its opportunities. Its suburbs and the islands of Casco Bay are every year being resorted to more by Canadians, who always meet with a hearty welcome from the hospitable people of the Maine coast, and who find in the temperate climate and bracing sea breezes of this region an ideal summer resort.

THE CEMENT INDUSTRY.

The great increase in the production of Portland cement in Canada is causing considerable remark among those interested in engineering and the building trades. There does not appear to be a corresponding expansion in the business of the producers of the natural rock or hydraulic cements, and these latter complain that there is a prejudice growing up which is against them, and in favor of Portland cement makers.

The peculiar qualities of Portland cement, as distinguished from the natural or rock cements, are: A very much higher strength at early dates; greater uniformity in manufacture, due to the constituents being brought together artificially and therefore being controlled with ease. It can be laid in frosty, even winter weather, with safety; it will stand wear of pavements, etc.

The characteristics of natural or rock cements, which commend them to use, are: Their continually increasing strength, by which in time they are nearly equal to Portlands; safeness, as they are not over-limed; cheapness, near point of manufacture, where early strength or frost proofness are not requisite, and where concretes are not to be immersed in water for several months.

THAT "COMPRESSED AIR" FIZZLE.

Readers of The Canadian Engineer will remember our discussion on some of the auto-car schemes exploited in the United States, and particularly the Croker-Leiter scheme, relating to compressed air auto-trucks. Complete verification of our prophecies is to hand, in the form of an announcement that all the compressed air companies and affiliated concerns—nominally capitalized at about forty millions—are all to be merged into one central corporation, with H. Payne Whitney, son of William C. Whitney, as president of the new company, which will have a nominal capital of one hundred millions. Does this mean that we are to see the auto-trucks by hundreds doing work in our streets? Not at all; for, as the Cycle Age well says, "Nothing has as yet transpired in the way of inventions or tests that would make compressed air appear as

available for ordinary motor vehicles. The compressed-air motor is chiefly adapted for street railway power and for heavy freighting over very short routes." But the compressed air exploiters started in to revolutionize all traffic in the big cities, and cartage companies and all haulage vans were to be done away with. Is there nothing left, then, for the compressed air magnates to exploit? Yes; electricity! It is soberly stated that "the American rights, under the Krieger electric patents, are reported to have been purchased by them, and they are known to be pursuing further investigations into motive powers." This statement is corroborated by the fact that the word "air" has been dropped from the title of the new company, which is "The International Power Company." The Horseless Age remarks: "Putting two and two together, therefore, it looks as if the sceptics were right, and we should not be afflicted with these barbarous 'auto-trucks' after all. Perhaps when the company really gets down to business we shall have good, common, everyday motor trucks propelled by steam, gasolene, kerosene, or anything but compressed air." Now we will be prepared for the collapse of the Whitney-Elkins-Widener windbag.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS TENTH ANNUAL CONVENTION.

Berlin, Ont., had the honor of entertaining the members of the C.A.S.E. for their tenth annual convention, and she proved a worthy hostess. The convention opened on the 15th August, and ended with a banquet on the evening of the 17th. The delegates, who were accompanied by their wives, made the Brunswick Hotel their headquarters. The executive and the balance of the delegates were assigned to the American House, and the banquet took place in the hall of the Walper House. The convention held their business meetings in the Christadelphian Hall.

Tenth Annual Convention Canadian Association Stationary Engineers

It was nearly noon on the 15th when President Bro. W. F. Chapman, in the chair, supported by Vice Pres. Bro. R. C. Pettigrew, opened the session with the following opening charge from the C.A.S.E. ritual: "Brothers—It is my duty to rule with justice, promptness and forbearance, and it is your duty to make our meetings entertaining and instructive, avoiding all useless discussions and personalities, upholding your obligations by using toward each other brotherly love and kindness. Thus securing the great object for which we are organized, that of meeting together socially for mutual improvement and discussing the best methods of managing the world's greatest motor, steam, and its appliance to power. I hope each brother will be decorous and attentive to the business of the evening. I now declare this association open for its legal business."

The following committees were selected by the president, the first named in each case being chairman:

Committee on Credentials—Bros. Edkins, Marr and Turkington.

Committee on Finance—Bros. Webb, Wickens and Pettigrew.

Committee on Mileage—Bros. Bain, Ironsides and Jamieson.

Good of the Order—Bros. Dixon, Wickens, Oelschlager, Moseley.

The following answered the roll call: Executive—Bro. W. F. Chapman, president; Bro. R. C. Pettigrew, vice-president; Bro. G. C. Mooring, treasurer and acting secretary; Bro. W. Bear, conductor; Bro. J. Wendell, door-keeper. The delegates from branch associations were: A. E. Edkins, J. D. Moseley, J. W. Marr, W. J. Webb, J. G. Bain, of Toronto No. 1; John M. Dixon, Toronto No. 18; Jos. Ironsides, Hamilton No. 2; J. Ogle, J. Forsyth, Brantford, No. 4; W. Jamieson, Dresden No. 8; W. Oelschlager, Berlin No. 9; R. Turkington, Brockville No. 15; F. A. Pflug, Waterloo No. 17. Other members present were, A. M. Wickens, E. J. Philip, J. G. Bain, Jas. Bannan, of Toronto; R. W. Greene, Guelph; Nathan Uttley, Waterloo; W. Liedt, J. Schneider, G. Steinmetz, W. Oelschlager, of Berlin; Jos. H. Walker, of Kincardine. Among the visitors present at the meetings were T. J. Halsey, of the Fairbanks Co. of Montreal, and his samples of valves, asbestos-packed blow-off cocks and asbestos ring gate valves, interested the members very much. W. V. Uttley, of Berlin News-Record, was unwearying in his attendance, and coming of an engineering family took an active interest in the meeting.

Welcome to Visiting Delegates by President Oelschlager, C.A.S.E., No. 9.

On behalf of the Berlin Association No. 9, I have great pleasure in extending to you, Mr. President, and delegates of the Canadian Association of Stationary Engineers, a hearty welcome to our town, on this the 10th annual convention. The growth of the association here has been slow but sure. The members of the Berlin branch, realizing the benefit of the meetings, are good in attendance. In conclusion we welcome you collectively and individually, and trust that your stay in this German city will be most pleasant and profitable.

Annual Address of President Chapman.

Brethren—I have the honor to welcome you to this our tenth annual convention. I am aware that in selecting you as delegates, our various branches have sent their best men. Consequently, I am confident that your deliberations will result in the advancement of our organization, and that in dealing with the various subjects brought before you, the one and only aim sought shall be the greater good of the C.A.S.E. I am sure that naught but good will shall prevail, indeed, such is one of

the cardinal principles of our order. I need not ask for your hearty support, as this has always been given to the occupant of the chair. We have not increased the membership during the past year, only one new association organized, and very few new members added to replace those who withdraw and those taken by death. But brethren, I have the pleasure of saying that we have received into the C.A.S.E., out in Calgary, a lot of energetic members, that in the near future will have their subordinate lodge second to none in our fair Dominion. I have also in my possession a letter from Bro. Wm. Cross, also one from a Mr. Cook, chairman of a committee appointed by the engineers out at Rossland, asking information as to the starting of an association in that place. So you see if we have lost in the east we have gained in the far west, where everything grows in abundance, and to an enormous size. You will be asked to look over a bill drafted by a committee appointed by the Ontario Association, also to give your opinions and co-operations, that a greater effort may be put forth to have the bill become law, at the next meeting of the Local House. In this connection I should say that in this movement, not only are the members of the two associations a unit in favor of such a law, but I might add, almost all the qualified engineers of this country are with us, as well as most of the steam users. It may be necessary at the present convention to again take up the matter of bi-annual conventions, with a view to the curtailment of the expense necessary for an annual meeting. Steps should also be taken to arouse the engineers of the Dominion to the loss they sustain in not being of our membership. I regret very much the steps taken by our secretary, also by Montreal No. 1. I presume most of you have seen the item in The Canadian Engineer, that Montreal had moved to withdraw from the executive. For what reasons? Because they did not get from the executive the results desired in accordance to what they pay in, also that the cost of attending the convention was too great. Now, brethren, do you think that is the object? They have had for the past two years the executive secretary, a man possessed of good ability, and I consider it the most important office in the executive. So if they have not obtained what they want in the way of information it is their own fault. I think it would be wise to appoint some good past president to the secretaryship, and keep him for a term of years, and have him devise some scheme whereby the subordinate associations will be drawn in closer touch with the executive head. For instance, he might send out problems to the different lodges, for them to work out and return, and any errors they might make could be rectified by him, whereby keeping up a correspondence, and making the executive head a medium of instruction. These are a few points I have brought out for your consideration, and I feel satisfied that your best judgments will be used in dealing with them. The finances will be dealt with by the executive treasurer, therefore I will not touch on them. Brethren, in conclusion, I desire to express to you my deep sense of gratitude for the great honor you conferred on me a year ago, when you elected me to the high and honorable position of president of this association, and for the loyal manner you have stood by me. In closing I will only add it is my heartielt wish that your deliberations at this convention may be so conducted towards each other that everything we shall do will redound to the benefit and honor of our good association.

Moved by Bro. Wickens and seconded by Bro. Pettigrew, that the president's address be handed to the Committee on the Good of the Order for discussion.

The minutes of the last meeting were then read by Treasurer and Acting Secretary Bro. G. C. Mooring, who was handicapped badly, owing to the poor notes of last meeting, and press of business coming on him in his dual capacity; he regretted that they had not been put into proper shape. They were adopted on a motion by Bro. Dixon, seconded by Bro. Edkins. The president informed the married men accompanied by their wives that carriages would be ready for the ladies at 2.30, for the purpose of giving them a drive round the twin cities. On a motion by Bro. Marr, seconded by Bro. Ironsides, and carried unanimously, it was decided to adjourn until 3 p.m.

At the afternoon session Bro. Oelschlager introduced Mayor Eden, and several of the councillors, and the delegates and visiting engineers listened with great pleasure to the following speech, in which the mayor gave them welcome:

Address of Welcome by Mayor Eden, of Berlin.

It affords me very much pleasure to meet the delegates of the Canadian Association of Stationary Engineers, and especially is it a pleasure to greet you in our town of Berlin. I am glad to see that a number of the delegates have brought their wives with them, for I feel satisfied that they will retire much earlier in consequence. The stationary engineer fills a most important position in connection with the welfare of the country. In the first place, they virtually hold the key to our manufacturing industries, whereby the trade and commerce of the land is very much increased. They also control to a great extent the labor employed in cities and towns, and without this employment, the cities and towns of our country would be very much reduced in prosperity and population. This must show to the engineers the necessity of each of you being intelligent and ingenious. A man to-day to be of any use in any profession must be more than a machine. You are showing your wisdom in forming yourselves into an association and meeting regularly to discuss new requirements in your particular lines. No doubt many of you are clever individually, but all can learn from one another. It should be your object to try and benefit your employer by giving him as much power as possible with the least expense. Now as mayor of this town, I extend to you all a hearty welcome to our town of Berlin—a town which we boast of as being the best in this fair Dominion—a town which employs to-day more stationary engineers than any other town its size in Canada. I understand that only a few of our engineers have as yet joined the association, but I trust your meeting here will act as a stimulus and result in having all our engineers identify themselves with the organization. Our town is known as a most hospitable one, and I can assure you the freedom of the city wherever you go. No doubt you will be most interested in our manufacturing establishments, and I can assure you from what I know of our manufacturers, it will be a pleasure for them to show you through their factories. I trust you will enjoy your visit here in such a way that you will see fit to meet here again in the near future, at which time we will have all our streets fixed up in keeping with the rest of the town. I again extend to you, friends, the freedom of our town.

Reply to Address of Welcome from Mayor Eden, of Berlin, by President Chapman.

Mr. Mayor and Aldermen:—

On behalf of the delegates here present, attending our tenth annual convention, I thank you for the honor you have done us in welcoming us in such a handsome manner to your beautiful town, noted not only for the proverbial hospitality of its citizens, but also for their well known go-aheadativeness and public spirit. We join with you, Mr. Mayor, in pride of the beautiful cities, towns and waters of this Canada of ours, and not only those are we proud of, but we are proud of our fair Dominion at large, believing that it is bound to become one of the greatest and grandest countries on this earth. And, Sir, appreciating this truth, it becomes us as engineers, to sow the seed of theory and practice combined, which are the fundamental principles of our order. I am sure the delegates, one and all, appreciate as highly as I do your presence amongst us. We have come together to combine business with pleasure. The object of our association is to help one another, not only in a social and brotherly way, but chiefly to educate ourselves in our calling, thus benefiting our employers as well as ourselves; and I am sure we are more than pleased to hear from the eloquent welcome you have tendered us, that you thoroughly understand our aims and objects. I feel sure that our sojourn in your town will be most agreeable and pleasant for us all, and that we shall return home carrying with us happy recollections of our stay in the beautiful town of Berlin. Our branch here is composed of energetic citizens, as is evidenced by the programme of entertainment provided for the entertainment of their visitors. When we add to this the hearty co-operation with them of the Chief Magistrate, and citizens generally, we have indeed reasons to approve of the decision of last year's convention, in deciding to come to Berlin. I need hardly say, Mr. Mayor and Gentlemen that during the proceedings of this convention, we shall at all times be pleased to have you attend our sessions when you feel disposed to do so. We have met with cordial receptions wherever the conventions of the association have been held, but

nowhere has it been more generous and hearty than in Berlin. Again Mr. Mayor and Aldermen, on behalf of the delegates here assembled, I thank you for your welcoming us to your town.

Bro. G. C. Mooring, in his capacity as acting secretary, then read the annual report, and his report as read brought member after member to their feet. It was certainly incomplete in many details, and it looked at one time as if the executive were somewhat to blame. Secretary Robertson had, according to his letter of explanation, met with various and trying accidents, and other experiences, which had all tended to a complete abandonment of his official duties, and the report was finally referred, on a motion by Bros. Dixon and Moseley, to the Finance Committee for analysis. Bros. Wickens, Webb and Pettigrew demanded an investigation, and were answered by Bro. Edkins, who said it would not help matters any even if the executive were dragged into the matter; he was followed by acting secretary Mooring, who explained matters from his standpoint as acting secretary, and had done all he could to give them facts. For a few minutes the executive had a busy time answering questions, which came thick and fast, and the atmosphere cleared only when Bro. Mooring read a private letter to himself, and in which the secretary took all the blame. It was a revelation to the representative of The Canadian Engineer how such matters could be discussed in such a fair manner, and how straight questions such as were asked could be answered calmly and without any show of personal feeling. It speaks well for the manliness of the individuals composing the C.A.S.E., and many executive heads could get good pointers from our C.A.S.E. in convention. The matter, however, was finally referred to the following special committee, consisting of Bros. Webb, Wickens, Pettigrew, Edkins and Dixon.

Forwarded to the Committee on the Good of the Order for a report on same, and moved by Bro. Edkins, seconded by Bro. Pettigrew, that the committee be given until Thursday a.m. to prepare their report. The treasurer, Bro. G. C. Mooring, then read his report for the year.

The following notices of motion were then given:

That our conventions in future be held every alternate year or bi-annually, instead of annually as at present.—John M. Dixon

That the per capita tax be reduced from 70c. to 50c. per year. —Chas. Moseley.

That two days session in future be the limited time apportioned conventions.—John Marr.

The report of the Credential Committee was on motion by Bro. Dixon, seconded by Bro. Wickens, accepted and referred to the Mileage Committee. Bro. Dixon, who is an indefatigable worker, and one of long experience, then read the report of the Parliamentary Committee. A discussion followed the reading of this, led off by Bro. Ironsides, and participated in by Bros. Wickens and others, and after being fully discussed and ample explanation given it, was received by Bro. Edkins and seconded by Bro. Bain, and the committee was dismissed. In connection with this report it might be said that last year a committee was formed, and Bro. Dixon was the convener. The members of the committee were stationed far apart, and as a result no concerted action was possible, so they had failed in their object. It was brought out in the discussion, before referred to, that to be a success the new committee would be chosen differently.

A copy of the new bill, which is proposed to be submitted to Parliament, was distributed at this stage of the proceedings, and after a motion had been made by Bro. Mooring, a committee of one, Bro. Oelschlager, was appointed to have badges made for the delegates. Meeting adjourned.

The programme for the evening was varied, and it was thoroughly enjoyed by all. At 9 p.m. special trolley cars supplied by Manager McLelan of the Street Railway Company carried the executive, delegates and ladies to the Zimmerman House at Waterloo, where a reception was tendered them by Waterloo Association No. 17. A pleasant time was spent. Bros. John M. Dixon and J. W. Marr supplying the vocal music, and the variety of the contributions was very great; many of the choruses were taken up by the crowd, and Bro. Dixon gave a creditable exhibition of the duties of a chorus leader, his invariable good nature and sympathetic remarks lifting the chorus singers far above the plane on which they had started and the presence of a number of German friends did not deter him in achieving his object. The gentlemen friends of the party having received an invitation to a German supper from Mr. Wegener, the party left for Berlin about 10 p.m., and soon afterwards were enjoying this unique feast of pretzel, Limburger cheese, brown bread, weiners and other delicacies of the Fatherland. Past President E. J. Philip put in an appearance, having travelled from Toronto in his automobile, accompanied by his mother, an old lady of 74 years of age. Toronto was left at 11 a.m. and Berlin was reached at 8 p.m., having travelled 70 miles. This was the first auto-mobile to enter Berlin, and attracted great attention. Bro. Philip was the centre of attraction for the newspaper men, and the fact really was, he was the most talked of man in town. He introduced his brother, G. O., who is one of Berlin's successful merchants, the manager of the Opera House, and a liberal-minded citizen. Songs and stories helped pass the time, and the host sang several German songs, his rendering of the well-known "Der Wacht Am Rhine," being particularly enjoyed by the English members of the party. The inn, which is named the "Progress," is a fac-simile of the German style.

Handsome mural paintings adorn the walls, and scrolls containing mottoes similar to the following are entwined with the figures: "First weigh, then risk it;" "Love what is rare," "Drink what is clear," "Speak what is fair," "Eat what is pure." Needless to say this supper was a grand success and was one of the most pleasant experiences of the Berlin meetings.

The convention re-assembled at 10.30, Wednesday morning. The first business attempted was the reading of Finance Committee's report. It was adopted and the committee discharged on a motion of Bros. Moseley and Webb. Next came the report on the Good of the Order, and it was decided to take up the report clause by clause. Bro. Dixon read the report through and then submitted

Clause 1. Resolved that the president's address contains much that is essential to the vitality of the association. His references regarding our development has a slightly regretful tone, but the causes certainly cannot be laid to our charge; they rather lie at the doors of those associated with us at the time, whom it was impossible to control, much less coerce into activity. Adopted on a motion by Bros. Wickens and Moseley.

Clause 2. Resolved that the outlook for our extension in the near future has a hopeful aspect, inasmuch as enquiries have reached us from the Pacific Coast, requesting organization under the C.A.S.E. charter, wishing to enroll themselves as comrades in the march. We suggest that all such enquiries be closely attended to by our incoming executive. Adopted on a motion by Bros. Ironsides and Oelschlager.

Clause 3. Relative to Bill proposed at last session of 1898 convention. Your committee formed at last convention found it impossible to take action for the following reasons: The O.A.S.E. took up the matter enthusiastically, and obtained an interview with the Hon. John Dryden, M.L.A., and at his suggestion they amended the Bill, and intend presenting the new version at the next session. We, your committee, desire to impress upon the individual members the necessity of supporting this association in their efforts on your behalf. Amendment to Clause 3, proposed by Bro. Moseley and seconded by Bro. Pettigrew, That the committee should recommend that a special committee be appointed to act in conjunction with the O.A.S.E., as a further means of support, also that funds be placed at its disposal to help in the forwarding of their object, and that they be realized by a special appeal through the executive to the primary associations. The amendment was incorporated with the original and adopted.

Clause 4. Resolved that president's suggestion that a past president be elected to the office of secretary is a wise one. We wish to add the following, that said office of secretary be held for a term of not less than two years, and the official be eligible for re-election at the pleasure of the convention. Adopted on a motion by Bros. Pettigrew and Mooring.

Clause 5. This clause after a great difference of opinion was withdrawn. It provided for the holding of the C.A.S.E. convention bi-annually. Since the subject was first brought forward some years ago, no method of coming to an agreement had been proposed. The general opinion in former conventions was against it. Converts, however, have been made, and yet many of the delegates had come unmstructed as to how their

vote should be cast. Interesting discussion for and against resulted. Bros. Pettigrew, Dixon, Bain and others spoke against the change, and argued strenuously for an annual meeting. Some of the speakers demanded a live, working executive as a cure for the apparent waning of interest. Bro. Dixon, in a fair, impartial manner, took up both sides of the question, and left it in the hands of the individual members, by suggesting a plebiscite vote, and wished to move an amendment to that effect, which was done, and the amendment carried by a majority of three. In connection with above Bro. Pettigrew advanced an argument, which, perhaps, was not noticed much at the time, but was discussed freely outside the convention. It was argued by him that the Canadian Electrical Association was a competitor of the members individually of the C.A.S.E. Now the Canadian Electrical Association is composed altogether of electrical experts and employers of labor in plants operated primarily by steam power or water, and it does not appear reasonable to consider them in the light of competitors of an institution which exists chiefly for the education of steam producers.

Clause 6. Notice of motion by Bro. Moseley, that per capita tax be reduced from 70c. to 50c. Adopted on a motion by Bros. Pettigrew and Edkins.

Clause 7 was withdrawn. It dealt with the time limit of conventions, and it was found that the constitution had covered the ground fully.

Clause 8. Resolved that the executive be reminded that a motion stands on the books regarding the issuing of instruction papers. So far no course of instruction has been brought to our notice which would be so effective in retaining the interest of our members and to enable them to come in closer touch. Your committee begs leave to emphasize this present motion and suggests that strong pressure be brought to bear on your executive in regard to the preparation of these question and answer papers, of such paramount importance to our individual members. Adopted on a motion by Bros. Edkins and Ironsides. All of which is respectfully submitted. Bros. Dixon, Oelschlager, Moseley, Wickens, committee.

The president received a telegram from Goldie, McCulloch Co., inviting the delegates to visit their works in Galt, and it was decided unanimously to accept the invitation for the afternoon. The convention at 12.30 decided to adjourn until 9.30 a.m., Thursday.

After dinner the train was taken for Galt, and the trip down was very enjoyable. In fact beautiful weather during the whole convention was the order. Just a short distance from Berlin we ran quite close to the sewage farms, and so far the disposal of their sewage has been accomplished successfully by this system.

The C.P.R. bridge at Galt was also an object of interest, particularly because the bridge has been raised some few feet without in any way interfering with the traffic. At last Galt was reached, and as it was the first visit of many to this thriving and pretty city of factories, many were the exclamations of interest as delegates recognized the familiar names of machinery manufacturers whose products they had used. Easily the largest of them all was the immense stone block of their hosts, and as they filed into the office of the firm Mr. A. R. Goldie met them and personally conducted them through the different departments. Mr. Goldie has the faculty of conveying very much information in few words, and is perhaps the youngest man in Canada occupying such a responsible position, being general superintendent of the entire works.

It is needless to say that the visitors were very much interested, they having no idea that the Goldie & McCulloch establishment was so large. They were much interested in the engine department; the immense floor of the erecting room was completely filled with engines in different stages of construction. Some of these were as large as 400 and 500 h.p.; there were Wheelock slow speed engines, and Ideal high speed engines, the latter suitable for direct connected electric lighting. After visiting this shop they went into the machine shop where the very latest improved lathes, planers, etc., were all busily engaged turning out work for these engines and other machinery. System and good management were apparent on every hand. The very best facilities for handling heavy work are placed for the convenience of the workmen all through the shops. The writer noticed that the most modern of machinists' tools were used by the workmen, and it might be of interest to lathe and planer users to know that Goldie & McCulloch Co. was the first in Canada to install the patent tool holders and boring bars manufactured by the Armstrong Bros. Tool Co., of Chicago.

If these two shops were of interest, perhaps the moulding shop proved even more interesting. This immense department is 100 feet long by 90 feet wide, equipped with all the very latest appliances for handling ladles and heavy castings. There is one Whiting travelling crane, entirely operated with compressed air, the capacity of which is 40,000 lbs. In addition to this are six hydro-pneumatic swinging cranes, placed on each side of the floor, making it possible to pass ladles and castings from one end of the shop to the other. The cupolas, of which there are three very large ones, are placed at one end of the shop, as are also three great core ovens; at the other end is the cleaning room, which has cranes and compressed air appliances of all kinds for cleaning castings. The brass foundry is in this same building, but separated from the moulding shop proper. After visiting the shops mentioned above the visitors were taken through the other departments, the wood working machinery, the gas engine and the flour mill machinery department, the safe works and the boiler and other shops. While these different departments were of much interest to the engineers, of course it cannot be expected that they took the same interest here that they did in the engine construction department. President W. F. Chapman, in a few well chosen words before the delegates left, tendered a very hearty vote of thanks to Mr. Goldie for his kindness and courtesy in showing them through the works, and Mr. Goldie fittingly replied, after which three hearty cheers were given for the Goldie & McCulloch Co., Limited, of Galt, Ont.

The balance of the time in Galt was spent in sight-seeing and visiting the many friends of the delegates, and at 7.30 all arrived back in Berlin, the evening being spent in visiting Victoria Park and other points of interest.

The final session commenced at 9 a.m., Thursday. The Mileage Committee read their report and it was adopted on a motion by Bros. Edkins and Pettigrew. In consideration of his long services and ever ready assistance, Bro. A. M. Wickens' name was added to the list, on a motion by Bros. Dixon and Moseley.

Report of special committee was then read by Bro. Dixon. They had the difficult duty of analysing the reports and letter of the secretary. After deliberation they had drawn up a letter which was deemed satisfactory, and to show their good-will to the members of the Montreal branch, which had withdrawn, it was embodied in the letter that the C.A.S.E. ask them to accept as a gift the charter, by way of a practical illustration of the good will extended.

The new Bill occupied the attention of the meeting for a short time, and on a motion by Bros. Moseley and Pettigrew a new Parliamentary committee was formed, Bro. Dixon, convener, and Bros. Edkins, Webb, Moseley and Mooring members. The sum of $50 was put at their service for contingencies. A motion was also carried to the effect that the incoming secretary be requested to purchase a new supply of by-law and constitution books, and was adopted unanimously.

The election of officers was the next order of business. Two scrutineers were appointed, Bros. Walker and Bear. For president, Bro. Pettigrew, acclamation; vice-president, Bro. Mooring, acclamation. Bro. Dixon was also nominated but refused to stand. The secretary, under the new law, was to be selected from the past-presidents, and Bro. A. M. Wickens was elected on his past record, unanimously. The treasurer's position was the first to require a vote, and Bro. Moseley was the choice. The position of conductor also required a vote, and Bro. Oelschlager was declared elected. The position of doorkeeper was the most exciting and last official voted for. Three candidates offered were Bros. Bear, Turkington and Dixon, and Bro. Bear was the fortunate one. Past President Chapman then installed the new officers; Bro. Webb acting as conductor for the occasion. A vote of thanks was tendered the scrutineers. Toronto was selected as next place of meeting. The new president presented the retiring president with the handsome past president's jewel, and the few words spoken by Bro. Chapman were full of feeling, and expressed his deep gratitude for the honor done

him, marking the cessation of duties as the representative head of such an honorable body of men.

Votes of thanks were passed to the Berlin association and the chairman of the Reception Committee for his arduous and successful work, which had made their visit so pleasant, to which Bro. Oelschlager replied; the ladies of Berlin for their hospitality in entertaining the visiting ladies, and Bro. Steinmetz was appointed the bearer of this vote to them. The acting secretary, Bro. Mooring, was voted a sum of money as a slight acknowledgment of his services, and his reply was an expression of his desire to reach the highest office in the C.A.S.E., and he thanked them for placing him a step nearer his goal. Bros. Wickens and Moseley also expressed their thanks for the honors tendered them. A vote of thanks was tendered the local press, The Berlin News-Record being mentioned in particular. The Canadian Engineer was also tendered a hearty vote of thanks. President Pettigrew then delivered the closing address, and intimated his desire to build up the association. He was proud of the executive chosen, and the election of a past-president to the position of secretary would do much to strengthen his hands, and could only lead to the best of results. He prophesied a great future for the C.A.S.E. The present convention had done much to clear away the obstructions hindering their progress, and the next convention would prove what he said. The National Anthem was sung heartily, and the convention was over.

THE BANQUET.

The convention was brought to a close by a banquet in the dining hall of the Walper House. The attendance was good, and the Berlin association could be congratulated on the manner in which everything was arranged. Bro. Oelschlager acted as chairman, and was supported at the head of the table by the officials and prominent guests. The chairman read letters of regret from Mayor Eden; Goldie, McCulloch Co., Galt; J. J. York, Montreal, and others.

The toast of the Queen brought into evidence the patriotic spirit of the guests, and the National Anthem was sung heartily. "Canada Our Home," was responded to by L. J. Breithaupt, M.L.A., and in reviewing the history of Canada the speaker made the statement that the diamond jubilee was the means of making Canada better known than any other event in her history. As an employer of labor he dwelt on the dignity of labor, the great future in store for us, the increase of the exports from Berlin and her sister city. He said much had yet to be done in the making of Canada's great and unbounded possessions known. Great ignorance of the actual condition of affairs in Canada at times came to his notice, whether feigned or not he could not say, but he did not think our resources were realized by the nation to the south of us. He believed that there was no reason why in course of time Canada should not develop her resources so as to rival the progress of the United States. In the unavoidable absence of Mayor Eden, Dr. Bowlby, deputy reeve, spoke to the toast of "Mayor and Council. The trade and commerce of Berlin was his subject. The great manufacturing concerns were fully described, and the speaker informed them that they were there to stay. Messrs. Rumpel and Hagen also spoke a few words in their position as aldermen. Mayor Diebel, of Waterloo, although far from being a well man, made a pleasant speech, and his jocular references to the leading products of Waterloo were fully appreciated. The executive head and delegates came next. President R. C. Pettigrew lauded the C.A.S.E. for their efforts along educational lines and considered them the greatest educational body in Canada, outside the Public Schools. Education and progress were the corner stone and motto respectively of the society; although only in existence for a little more than twelve years, having had great difficulties in its path, and many prejudices to overcome, it kept steadily advancing, and now numbered over 20 branches, and if legislation such as they asked for was granted they would feel as if they had accomplished something. Vice President Mooring and Treasurer Moseley followed with remarks of gratification suggested by the good time they had enjoyed in Berlin. Manufacturing Interests was responded to by Samuel Rogers, president Queen City Oil Co. Mr. Rogers is a self-made man, and in his remarks connected with reminiscences of the winter of 1844 his experiences are typical of the hard road to success travelled by the farmer's son in the early days of a new country. At that time his sole ambition was to own a farm; however, when that object was gained, his ambition was still far from satisfied, and up through the years he kept advancing until his present position rewarded him. Canada's great wealth and the great future were subjects upon which the speaker spoke eloquently. His advice to the Canadians was to keep their resources and young men in Canada, particularly referring to the eagerness with which young men from our country were sought after by the business men of the neighboring Republic. Mr. Rogers concluded his speech with a detail of figures, and a very interesting account of the savings made in the oil factories from the utilization of the by-products. Mr. Anthes, a prominent manufacturer of Waterloo, also spoke. Educational interests were ably championed by Hugo Krantz, and his remarks were interesting in the extreme. With Germany as an example he related how she had taken steps when her trade was small, compared with other nations, to find out what she lacked. The establishment of technical schools and polytechnic institutions marked the beginning of a new era in her affairs of commerce, and to-day she stands in the front rank of the manufacturers. He made a strong plea for education of the practical man, and has worked for years on these lines, and the material in Canada, and the men were the equals of Germany, and Canada would prosper if that same idea that was embodied in the German manufacturing circles of training the working man first practical, then theoretical, was adopted. Sister associations were ably spoken for by E. J. Philip and A. M. Wickens, and their endorsation of the demand for legislation was strongly put, particularly by the last named. The Press were well represented, and as the hour was late their remarks were short. Messrs. Motz, Journal; Lutz, News-Record; Young, Electrical News, and Arch'd W. Smith of The Canadian Engineer, all replied to the toast. The Ladies were well cared for by D. B. Dover of the G.T.R. and G. O. Philip, both of whom spoke as if the subject was a pleasing one. Our Host and Hostess—in the absence of A. Walper, G. O. Philip spoke in his place, and the meeting dispersed with the familiar strains of "Auld Lang Syne," and "God Save the Queen."

Amongst the guests present were: H. D. McConochie, Galt; A. F. Masters, Detroit; Otto Werner, Sebastian Englert, R. Cossey, Aurcleas Moses, Alfred Vice, Albert Arndt, D. B. Doar, J. P. Wegener, Conrad Gildner, J. E. Belger, John Schneider, of Berlin; R. W. Turkington, Brockville; J. H. Clappison, Hamilton; G. Byers Towers, Jas. Bannan, Jas. Bain, A. E. Edkins, Toronto; H. A. Simpson, John L. Wendell, M. D. Caldwell, A. Stockfisch, Nath. Beam, John Nihell, Gideon Beam, F. A. Pflug, Jno. R. Uttley, of Waterloo; W. Mielke, New Hamburg.

W. OELSCHLAGER.

W. Oelschlager is of German descent, and was born in Waterloo county, Ont., in 1857. He learned the machinist's trade with J. Bricker & Sons, of Waterloo. Had two years' course in Worcester School of Technology, Mass., and graduated with honors. Was employed in the following shops: Chicago, West Michigan Railroad shops, Muskegon, E. P. Allis Co., Milwaukee, Chicago, Milwaukee and St. Paul railroad shops, Milwaukee, A. O. Pray & Co., Minneapolis, C.P.R., Winnipeg, and E. E. Gilbert & Sons, Montreal; was with this firm for three years and had charge of their machine shop for

two years, and left them in 1884 to start a shop himself in Port Elgin. Mr. Oelschlager carried on the shop for ten years, and five years ago removed his shop to Berlin. He has been a member of C.A.S.E. No. 9 for four years, and holds O.A.S.E. first-class certificate.

CHAS. MOSELEY.

Chas. Moseley, the newly elected treasurer of the Canadian Association of Stationary Engineers, was born at Chart, near Sutton, Eng. At the age of 11 he began his mechanical education by entering the machine shop of Steaven, Hooker & Co., and at 16 had charge of their steam plant. In 1884 he left England and sailed for Canada. Arriving in Toronto, he secured a position with John Fletcher, builder and contractor, as engineer. He remained with Mr. Fletcher for six years, leaving to accept a position with the Mail Publishing Co., Toronto, but after six months returned to his former employer, for whom he worked one year. Later Mr. Moseley secured the position of engineer of the North Toronto Electric Light and Waterworks, and in August, 1893, he accepted his present responsible position as chief engineer of the Incandescent Toronto Electric Light Co., on Terauley street, Toronto.

The portraits and biographical sketches of the other officers have already appeared in former issues of THE CANADIAN ENGINEER.

DRAFT OF BILL.

An Act for the protection of Life and Property in the use of Stationary Boilers and Engines, and the Examination and Licensing of persons in charge of them.

Whereas special provisions have been made by law for inspecting marine boilers and engines, and, as a result, the precautions made necessary by the owners in complying with the said law have had the effect of reducing accidents by boiler explosions to a minimum; and whereas the boiler explosions in the use of stationary engines and boilers have of late years increased alarmingly and been the means of destroying a large number of lives, and a great amount of property, through defective plant, the carelessness of owners, and the lack of knowledge of the men in charge; and whereas it is expedient in the interests of the public that the like means of prevention of such explosions and accidents should be applied to stationary boilers and engines, as to marine boilers and engines;

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. This Act may be cited as An Act for the Protection of Life and Property in the use of Stationary Boilers and Engines and the Licensing of Engineers in charge of them.

2. In this Act unless the contents otherwise requires.

(1) The expression "Boiler" does not include boilers used for heating water for domestic purposes or low pressure steam heating boilers, unless the pressure exceeds fifteen pounds per square inch, or railway locomotive or steamboat boilers, but means and includes all other steam boilers and every part thereof, or thing connected therewith, and all apparatus and things attached to or used in connection with any such boiler.

(2) The expression "Owner" means and includes any person, firm or corporation, the owner or lessee of the boiler, and the manager or other head officer in charge of the business of any such firm or corporation.

(3) The expression "Engineer" means any person having charge of or operating a steam boiler, under the provisions of this Act.

(4) The expression "Inspector" means any inspector of steam boilers appointed by the Lieutenant-Governor-in-Council under the provisions of this Act.

3. The Lieutenant-Governor-in-Council shall appoint an inspector or inspectors of steam boilers for the province, for the purpose of carrying out the provisions of this Act, and may fix the remuneration to be paid such inspector or inspectors, and may divide the province into districts, and appoint one or more inspectors in each district. Such inspectors shall constitute a board of boiler inspection, who shall meet from time to time as may be required, and who shall have power to formulate uniform rules and regulations for the inspection of boilers, and the examination of candidates for certificates of fitness as engineers under the provisions of this Act, and upon the approval of same by the Lieutenant-Governor-in-Council, such rules and regulations shall have the same force as the provisions of this Act.

4. No person holding the office of inspector under the provisions of this Act shall be either directly or indirectly interested in the sale of boilers or steam machinery, or any kind of supplies used in connection therewith.

5—(1) Every inspector appointed under the provisions of this Act shall, before entering upon the performance of his duties, take and subscribe an oath that he will faithfully and impartially perform the duties of his office, and also give security for the due performance of his duties in the sum of $2,000. He shall have had at least five years experience as a practical engineer in charge of a steam engine.

(2) Every inspector appointed under the provisions of this Act shall be practically conversant with the manufacturing and working of boilers, and shall also be a competent and practical engineer, especially conversant with the manufacturing and working of steam boilers, and shall hold the highest grade of certificate granted by the Ontario Association of Stationary Engineers, or a first-class engineer's certificate from the Minister of Marine and Fisheries, under R.S.C., chapter 78, section 41.

6. The inspectors appointed under this Act shall, under the direction of the Lieutenant-Governor-in-Council, make such rules for the uniform inspection of all steam boilers coming within the provisions of this Act, as will ensure the careful, thorough and systematic inspection of all boilers once, at least, in every year.

7. The provisions of this Act respecting the inspection of boilers shall not apply to any boiler insured and inspected by a duly incorporated or duly licensed boiler insurance company, legally doing business in Canada, if the owner or owners of such boiler shall, when required by an inspector appointed under the provisions of this Act, produce the certificate of inspection from such a company.

8. The inspectors shall examine all persons applying for certificates under this Act, and shall have power to issue certificates of competency according to the experience, knowledge and qualifications, subject to the rules and regulations made and approved of by the Lieutenant-Governor-in-Council, from time to time.

9. All certificates shall be exposed to view in a conspicuous place in the engine or boiler room.

10. Every engineer or fireman, or holder of a special certificate who undertakes to operate or take charge of any steam plant, requiring a higher grade of certificate than he possesses, shall be liable to a penalty not exceeding Fifty Dollars, and not less than Ten Dollars, upon the conviction of the same offence, and the inspector may revoke his certificate.

11. Every person who has charge of an engine or boiler to which this Act applies at the time of the passing thereof, shall upon the payment of a fee of two dollars to the inspector, be entitled to receive a permit to operate such steam plant for the term of one year, and every such engineer or fireman who applies for a renewal or higher grade of certificate, may procure the same by passing the necessary examination before the inspector, and shall pay for the certificate the sum of five dollars.

12.—(a) Every person to whom the provisions of the next preceding section does not apply, who presents himself for ex-

amination, shall pay the sum of five dollars for such examination. Each certificate shall have force and effect for the term of one year, unless sooner revoked for cause, and for each renewal the sum of one dollar shall be paid. The inspector shall not issue in any case a certificate to a person of intemperate habits, however skilful he may be.

(*b*) Every person who has had charge of an engine or boiler to which this Act applies at the time of the passing thereof, for the period of ten years prior to the time of the passing hereof, shall upon the payment of a fee of five dollars to the inspector, and upon furnishing proof of such service and of good character from his employers, be entitled to receive a second class certificate.

13. Every inspector appointed under this Act shall have power to revoke the certificate of any engineer in his district, if the person holding the same shall have committed any act or acts that shows him to be unworthy, incompetent or intemperate; but such person may appeal from the decision of the inspector to the Minister of Agriculture.

14. No person shall employ another as engineer, and no person shall serve as engineer unless the person serving or as employed as engineer is then licensed by an inspector as aforesaid, and any one who violates any of the provisions of this section shall be liable to a penalty not exceeding two hundred dollars, and not less than fifty dollars.

15. All moneys collected for certificates or renewals under this Act shall be paid to the inspector who issues the certificates, and who shall remit the same to the Provincial Secretary, together with a statement showing the names and addresses of the persons paying the same.

16. All prosecutions under this Act may be brought before any of Her Majesty's justices of the peace in and for the county in which the offence was committed, and in cities, towns and incorporated villages where there is a police magistrate, before such magistrate.

17. Every inspector shall keep a true record of all boilers inspected, and all repairs ordered by him, of all boilers condemned by him as unsafe, of all accidents to boilers in his district whether by explosion or otherwise, of all casualties in connection with boilers in his district.

18. Whenever any licensed engineer or inspector shall discover that the boiler he is operating has become weakened or unsafe, he shall at once notify the proprietor, owner or manager of the fact, and demand that they be repaired and made safe. If the owner, proprietor or manager shall refuse or neglect to have the needed repairs made, the engineer or inspector shall at once notify the board of inspectors of such refusal or neglect.

19. The board shall thereupon order a thorough inspection to be made, and, if said boiler proves on inspection to be unsafe, the proprietor or manager shall forthwith have the needed repairs made, and any owner, proprietor or manager who shall attempt to operate any boiler after such inspection, before having the needed repairs made, shall on conviction be fined not less than $ nor more than $

20. Any boiler operated at a pressure of fifteen pounds or less to the square inch, shall not come under the provisions of this Act, except those under sidewalks in cities or towns.

21. On the occurrence of an explosion from any boiler to which this Act applies, notice thereof shall be sent within twenty-four hours thereafter, to the inspector within whose jurisdiction the explosion took place, by the owner or by the user, or by the person acting on behalf of the owner or user.

22. The notice shall state the precise locality, as well as the day and the hour of the explosion, the number of persons injured or killed, in addition to the purposes for which the boiler is used, and generally the part of the boiler that failed, and the extent of the failure, and such other particulars, if any, as the Lieutenant Governor in Council may from time to time require.

23. If default is made in complying with the requirements of this section, the person in default shall on summary conviction be liable to a fine not exceeding one hundred dollars.

24. On the receipt of a notice of a boiler explosion the inspector shall fully investigate the causes and circumstances attending the explosion, and such investigation shall be held at or as near the place of such explosion by the said inspector, in such a manner and under such conditions, as the Lieutenant Governor-in-Council may from time to time deem most effectual, for ascertaining the causes and circumstances of the explosion, and for enabling the said inspector to make the report hereinafter mentioned.

25. The inspector making such investigation with respect to any boiler explosion shall present a full and clear report to the Minister of Agriculture, stating the cause of the explosion, and all the circumstances attending the same, as shown by the evidence, adding thereto any observation thereon, or on the evidence, or on any matters arising out of the investigation, which they may think right to make.

26. In the case of an explosion taking place on any stationary boiler for which the owner or user has not obtained a certificate of fitness, from an inspector under this Act, or from an inspector of a duly incorporated boiler insurance company, and any persons killed or injured thereby, or any property destroyed or injured, the owner or user of such boilers shall prima facie be deemed guilty of negligence, and liable for any injury occasioned by such explosion, and the onus shall be on the owners or users of the said boilers, to show that all reasonable and proper precautions had been taken to prevent such explosion or accident.

27. Provided that no part of this Act, except section 26, shall be deemed to apply or to affect the operations of steam engines or boilers, upon any farm for threshing, or other agricultural purposes.

28. For every inspection and certificate thereof under the provisions of this Act, the inspector shall be entitled to receive from the owner or user of a boiler a fee of five dollars. If two boilers are inspected at the same time a fee of eight dollars, and if three boilers are inspected at the same time a fee of ten dollars, and for each additional boiler inspected a fee of two dollars more.

MCLACHLAN ELECTRIC AND GASOLINE MOTOR CO., TORONTO.

Users of power do not need to be introduced to J. C. McLachlan, formerly of the Toronto Electric Motor Co., Ltd., and will be interested in the departure which he has made by adding the manufacture of gasoline engines, both marine and vehicle types, to the electric motors which he has successfully supplied for many years. The vehicle shown in the illustration is equipped with one of these motors and weighs complete less than 500 lbs. These engines can be applied to owners' traps. When equipped with base this motor is valuable for use as a small stationary engine. The marine type is very light, and weighs under 175 lbs. for 3 h.p. It has been installed in a launch 21 feet by 5 feet, for T. E. Caffe, of the Empire Cloak Co., Toronto, and is said to afford the most complete satisfaction in every way. All particulars may be had of the builders, The McLachlan Electric and Gasoline Motor Co., 94 Adelaide street west, Toronto.

C. F. McGill, mechanical superintendent of the Canadian General Electric Co., Peterborough, Ont., has moved his family from Schenectady, N.Y., to Peterborough.

PRODUCTION OF ORES AND MINERALS IN THE UNITED STATES. (FIRST PRODUCTS.)

Number.	Products.	Customary Measures.	1897. Quantity. Customary Measures.	1897. Quantity. Metric Tons.	1897. Value at Place of Production. *a* Totals.	1897. Value at Place of Production. *a* Per M. Ton.	1898. Quantity. Customary Measures.	1898. Quantity. Metric Tons.	1898. Value at Place of Production. *a* Totals.	1898. Value at Place of Production. *a* Per M. Ton.
1	Asbestos	Sh. T.	840	762	$12,950	$16·90	885	803	$13,425	$16·72
2	Asphaltum	Sh. T.	27,397	24,854	480,620	19·58	25,000	23,306	482,175	20·69
3	Asphaltic limestone	Sh. T.	2,380	2,168	11,450	5·28	14,000	12,701	70,495	5·51
4	Bitumin's sandstone	Sh. T.	47,470	43,065	136,173	3·16	49,536	44,938	146,275	3·26
5	Barytes	Sh. T.	26,430	23,977	105,720	4·41	28,247	25,626	112,988	4·41
6	Bauxite	L. T.	20,500	20,919	51,475	2·46	26,791	27,220	66,978	2·46
7	Borate of calcium, c.	Sh. T.	19,400	17,600	388,000	n22·05	15,335	13,911	306,700	n22·05
8	Bromine	Lb.	487,140	221	136,402	617·19	486,978	221	136,354	617·19
9	Cement, nat. hydraul.	gBbls	7,800,573	1,073,742	3,976,050	3·70	8,161,078	1,110,552	3,819,995	3·44
10	Cement, Portland	hBbls	2,439,003	441,090	3,724,905	8·45	3,584,586	650,383	6,168,106	9·48
11	Chrome ore	L. T.	150	152	1,550	10·17	100	102	1,000	9·84
12	Clay products				56,487,537				58,470,543	
13	Coal, anthracite	Sh. T.	52,645,133	47,750,351	85,857,717	1·80	52,848,605	47,943,940	81,445,937	1·70
14	Coal, bituminous	Sh. T.	148,155,567	134,405,849	120,013,372	0·89	165,208,025	149,875,737	128,419,354	0·86
15	Coal, cannel	Sh. T.	56,511	51,266	153,145	2·99	49,880	45,259	134,700	2·98
16	Cobalt oxide	Lb.	19,300	*k* 8,754	30,880	*k* 3·53	9,640	*k* 4,373	15,424	*k* 3·52
17	Copper sulphate, *f.*	Lb.	16,731,247	7,589	645,836	*m* 5·10	28,061,501	12,729	956,897	*m* 7·518
18	Corundum	Sh. T.	293	266	19,810	74·47	786	713	63,630	89·24
19	Emery	Sh. T.	1,900	1,724	92,000	53·36	2,956	2,682	143,800	53·62
20	Feldspar	L. T.	21,901	22,251	111,392	5·01	21,350	21,692	107,147	4·94
21	Fluorspar	Sh. T.	4,739	4,299	36,264	8·44	12,145	11,018	96,985	7·89
22	Fullers earth	Sh. T.	17,195	15,599	92,398	5·92	15,553	14,110	87,365	6·19
23	Garnet	Sh. T.	2,301	2,051	60,333	32·35	2,882	2,615	82,930	31·71
24	Grahamite	Sh. T.	1,750	1,593	52,680	n33·07	2,675	2,427	80,250	n33·07
25	Graphite, crystalline	Lb.	993,128	*k* 450,484	*m* 44,691	*k* 0·10	1,647,679	*k* 747,382	*m* 148,291	*k* 0·20
26	Graphite, amorphous	Sh. T.	1,200	1,089	11,400	10·47	1,200	1,089	11,400	10·47
27	Gypsum	Sh. T.	300,369	272,493	889,177	3·26	348,686	316,326	989,589	3·13
28	Iron ore	L. T.	18,285,405	18,587,772	30,941,379	1·67	20,655,865	20,986,359	37,593,674	1·79
29	Magnesite	Sh. T.	*c* 1,907	1,730	*c* 7,628	4·41	*c* 2,355	2,136	*c* 9,420	4·41
30	Manganese ore, *i*	L. T.	158,600	161,147	328,176	2·04	217,282	221,279	481,127	2·17
31	Mica, scrap	Sh. T.	2,882	2,615	*o* 28,820	11·02	3,529	3,201	*o* 39,837	12·44
32	Mica, sheet	Lb.	118,852	*k* 53,911	83,298	*k* 1·55	109,968	*k* 49,881	91,432	*k* 1·83
33	Molybdenite	Sh. T.	*Nil.*	*Nil.*	*Nil.*	*Nil.*	8	7	400	57·14
34	Monazite	Lb.	40,000	18	2,000	110·23	*d* 150,000	68	*e* 7,500	110·23
35	Natural gas				*e*10,000,000				*e*10,500,000	
36	Ocher, *p*	Sh. T.	12,590	38,637	468,490	n12·13	41,950	38,057	461,450	n12·13
37	Petroleum, crude	gBbls	57,124,783	7,962,040	39,372,811	4·93	51,774,465	7,243,509	42,100,522	5·81
38	Phosphate rock	L. T.	1,007,367	1,023,485	3,022,101	2·95	1,257,645	1,277,717	4,335,025	3·41
39	Precious stones				*d* 101,000				*e*125,000	
40	Pyrites	L. T.	133,368	135,502	404,690	2·99	191,160	194,219	589,329	3·03
41	Salt, *q*	Bbls	15,822,923	2,009,625	3,898,556	1·94	18,756,304	2,382,197	4,753,664	2·00
42	Silica, brick	M.	20,235		323,561		33,449		590,254	
43	Diatom. earth	Sh. T.	3,000	2,722	30,400	11·17	1,392	1,263	11,062	8·71
44	Flint	Sh. T.	28,402	25,771	55,811	2·17	35,593	32,290	73,313	2·27
45	Sand, etc	L. T.	*e* 750,000	762,000	*e* 1,125,000	1·48	*e* 800,000	812,800	*e*1,178,560	1·45
46	Pumice	Sh. T.	1,700	1,542	8,500	*n* 5·51	144	131	720	*n* 5·51
47	Grindstones	Sh. T.	36,502	33,114	342,186	10·33	38,859	35,253	488,675	12·41
48	Whetstones				97,239				107,996	
49	Tripoli	Sh. T.	1,631	1,480	5,475	3·70	1,865	1,692	3,367	1·99
50	Slate, roofing	Sq'es.	932,124	281,872	2,829,536	*j* 3·04	1,136,632	343,715	2,958,496	*j* 2·60
51	Manufactures				595,105				528,856	
52	Pigment	Sh. T.	6,857	6,221	57,863	9·30	7,886	7,154	70,671	9·88
53	Soapstone	Sh. T.	16,904	15,335	169,040	*n* 11·02	18,862	17,111	158,635	9·2
54	Soda, natural, *r*	Sh. T.	6,350	5,761	95,400	16·56	7,150	6,486	94,650	14·5
55	Stone, for building				*e*30,000,000				*e*32,500,000	
56	Stone, limestone (flux)	L. T.	4,247,688	4,315,651	1,868,983	0·43	5,275,819	5,360,232	2,894,900	0·54
57	Stone, lithographic	Sh. T.	*Nil.*	*Nil.*	*Nil.*	*Nil.*	112	102	*n* 2,240	*n* 21·99
58	Strontium sulphate	Sh. T.	40	36	200	*n* 5·55	2	2	10	*n* 5·55
59	Sulphur	L. T.	1,690	1,717	34,814	*m* 20·28	2,726	2,770	59,754	*m* 21·57
60	Sulphuric acid, *f. l.*	Sh. T.	42,352	38,421	699,655	*m* 18·21	47,558	43,144	970,183	*m* 22·49
61	Talc, common	Sh. T.	10,164	9,221	90,908	9·86	9,112	8,266	78,645	9·52
62	Talc, fibrous	Sh. T.	52,836	47,933	283,685	5·92	54,807	49,721	285,750	5·75
63	Tungsten ore	L. T.	(*b*)	(*b*)	(*b*)	(*b*)	78 865	80·13	17,398	217·12
64	Uranium ore	Sh. T.	17	15	9,010	600·67	33	30	16,500	550·00
65	Wulfenite	Sh. T.	*Nil.*	*Nil.*	*Nil.*	*Nil.*	12	11	144	13·09
66	Zinc sulphate	Sh. T.	*Nil.*	*Nil.*	*Nil.*	*Nil.*	145	132	4,640	35·15
67	Zinc ore, exported	Sh. T.	9,251	8,393	211,350	25·18	11,782	10,688	299,870	28·05
68	Zinc white, *s*	Sh. T.	26,262	23,825	1,686,020	70·77	32,747	29,708	2,226,790	74·95
69	Est. prod. unspecified				5,000,000				5,000,000	
	Totals				407,913,912				433,659,141	

REFERENCES.

In using the statistics in the foregoing tables, reference should also be made to the detailed tables under the respective captions further on in this volume, where many explanatory notes as to the statistics will be found. The following notes refer to the four preceding tables: *(a)* Except where otherwise specified. *(b)* Not enumerated. *(c)* Amount or value of crude mineral. *(d)* Partly estimated. *(e)* Estimated. *(f)* Amount recovered as a by-product. *(g)* Barrels of 300 lb. *(h)* Barrels of 400 lb. *(i)* Includes manganiferous iron ore; this is not duplicated in the report of iron ore. *(j)* Value per square, i.e., 100 sq. ft. lapped and laid; the weights are calculated on the basis 3 squares = 2,000 lb., but these figures are only approximately correct. *(k)* Kilograms or per kilogram. *(l)* Reduced to a basis of 66° B. *(m)* Average market price at New York. *(n)* Nominal. *(o)* Value before grinding. *(p)* Includes ocher, umber, sienna, and oxide of iron. *(q)* Includes salt used for the manufacture of alkali; the barrel of salt weighs 280 lbs. *(r)* Reduced to a basis of 58 per cent ash. *(s)* Includes a small amount made from spelter. *(t)* Average value of lake copper at New York, less 0.25c. per lb. *(u)* Includes spiegeleisen, though the total value is reckoned as if the whole product were ferromanganese. *(v)* Average market price at Pittsburg. *(w)* Troy oz. *(x)* Flasks of 76.5 lb. *(y)* Barrels of 42 gal. *(z)* Includes a comparatively small amount made directly from ores. *(aa)* Not included in the preceding tables.

Abbreviations: Sh. T., short tons (2,000 lb.), L. T., long tons (2,240 lb.); M. T., metric tons (2,204.6 lb.).

UNITED STATES MINERAL AND METAL PRODUCTION IN 1898.

The statistics of mineral production in the United States, as furnished by the producers and others for The Mineral Industry, Volume VII., compiled by Richard P. Rothwell, editor of the Engineering and Mining Journal, have now been completely collected and arranged, and are presented in the accompanying tables. These show a production which, in nearly all the more important substances, is the greatest ever recorded. The United States was, in 1898, by far the largest producer of iron and steel in the world; was second only to Great Britain—and then by a very small quantity—in the production of coal; and furnished more than half of the total copper supply of the world.

In accordance with the usual practice there is added to the columns containing the customary measures, others giving the weights, in metric tons, or other measures. Comparison with foreign reports is then easy, and the statements are recorded in a form which will be of still greater value hereafter. Mr. Rothwell hopes that, in a very few years, we may be able to dispense altogether with the column of "customary measures," and that the metric measures will then be the customary ones also. The figures in the table and the brief notes which follow will fully explain the course of the mineral production during the year 1898. The total value of the mineral production of the United States in 1898 was $700,816,750, against $648,804,899 in 1897. Of the production in 1898, $314,255,620 was the value of metals against $272,178,392 in the previous year, and $433,659,141 ores and minerals, against $407,913,912 in 1897. The values given for ores and minerals include $38,098,011 in 1898 and $31,287,405 in 1897 for bauxite, manganese and iron ores, which were used for making aluminum, ferromanganese and pig iron. These duplications were deducted in the aggregate values stated above. Eighteen secondary products for which statistics were collected, derived from some of the ores included in these totals, had an aggregate value of $49,432,829 in 1898, against $41,718,420 in 1897. There was also a production of copper, lead, silver and gold from foreign ores and bullion, valued at $58,948,125 in 1898, against $47,127,174 in 1897. In the preparation of the statistics for this volume the figures previously reported for 1897 have been revised in the light of later and more minute investigation.

THE LATE J. H. KILLEY.

The name of the late J. H. Killey, of Hamilton, Ont., was very familiar to the readers of The Canadian Engineer two or three years ago, when he was a frequent contributor to its columns. Mr. Killey died very suddenly from heart failure, August 10th. Just before retiring he complained of a slight cold, but about 2 a.m. he awoke Mrs. Killey, telling her that he had a choking sensation in his throat. Within a few moments he fell back on his pillow, expiring before medical aid could be procured. He leaves a widow and three sons, the latter being Wm. Killey, of Hamilton, Ont.; James, of British

PRODUCTION OF METALS IN THE UNITED STATES.

Number.	Products.	Customary Measures.	1897. Quantity. Customary Measures.	1897. Quantity. Metric Tons.	1897. Value at Place of Production. a. Totals.	1897. Value at Place of Production. a. Per M. Ton.	1898. Quantity. Customary Measures.	1898. Quantity. Metric Tons.	1898. Value at Place of Production. a. Totals.	1898. Value at Place of Production. a. Per M. Ton.
					$	$			$	$
70	Aluminum	Lb.	4,000,000	k1,814,388	m1,400,000	k0·77	5,200,000	k2,358,705	m1,690,000	k0·72
71	Antimony	Lb.	1,500,000	680	107,250	157·72	2,000,000	907	165,000	181·92
72	Copper	Lb.	501,370,295	227,420	t55,351,281	243·40	535,900,232	243,083	t63,129,047	259·70
73	Ferromang'nese.u	L. T.	173,695	176,474	v7,989,970	45·28	213,760	217,189	v10,474,681	48·23
74	Ferromolybden'm	Lb.	*Nil.*	*Nil.*	*Nil.*	.....	2,100	.....	1,050	1,102·30
75	Gold	n Oz.	2,884,576	k89,692·4	59,210,786	660·04	3,148,642	697,933	65,082,430	4664·60
76	Iron, pig	L. T.	9,478,085	9,630,649	v91,009,633	9·45	11,560,165	11,745,128	v110,168,372	9·38
77	Iridium	n Oz.	20·25	.....	606	.....	8·5	.....	255	.....
78	Lead	Sh. T.	197,718	179,389	m14,156,609	78·93	228,475	207,271	m17,272,710	83·33
79	Molybdenum	Lb.	*Nil.*	*Nil.*	*Nil.*	.....	9,550	4,332	11,937	k2·76
80	Nickel	Lb.	33,700	k15,286·2	m11,667	k0·76	11,145	k5,055·3	m3,845	k0·76
81	Platinum	n Oz.	200	k 6·2	2,468	396·78	300	k 9·3	3,837	k411·25
82	Quicksilver.x	Flasks	20,670	905	910,418	1,005·98	30,493	1,058	1,109,945	1,049·69
83	Silver	Oz.	56,457,292	k1,756,004·0	33,735,815	mk19·22	58,763,127	k1,827,723	34,670,245	mk18.97
84	Tungsten	Lb.	*Nil.*	*Nil.*	*Nil.*	.....	33,200	k15,059	43,160	k2·87
85	Zinc	Sh. T.	100,387	91,070	8,271,889	m90·83	114,104	103,514	10,429,106	m100·75
	Totals	.....	.....	.....	272,178,392	.....	.....	.....	314,255,620	.....

SECONDARY MINERAL AND CHEMICAL PRODUCTS OF THE UNITED STATES.

Number.	Products.	Customary Measures.	1897. Quantity. Customary Measures.	1897. Quantity. Metric Tons.	1897. Value at Place of Production. a. Totals.	1897. Value at Place of Production. a. Per M. Ton.	1898. Quantity. Customary Measures.	1898. Quantity. Metric Tons.	1898. Value at Place of Production. a. Totals.	1898. Value at Place of Production. a. Per M. Ton.
					$	$			$	$
86	Alum	Sh. T.	15,456	14,022	463,680	m33·06	18,791	17,047	563,730	m33·07
87	Aluminum sulphate	Sh. T.	46,355	42,053	1,158,875	m27·56	56,663	51,404	1,416,575	m27·56
88	Ammonium sulphate	Sh. T.	3,111	2,822	136,884	m48·51	3,589	3,256	179,450	m55·11
89	Calcium carbide	Sh. T.	1,925	1,746	134,750	77·18	(b)	(b)	(b)	(b)
90	Carborundum	Lb.	1,242,929	564	153,812	272·72	1,594,152	723	151,444	209·47
91	Cement, slag	Bbls	40,000	7,258	60,000	8·27	157,662	28,606	235,721	8·24
92	Coke	Sh. T.	12,768,891	11,583,862	23,203,920	2·00	15,897,797	14,422,387	30,505,563	2·12
93	Copperas	Sh. T.	15,702	14,245	78,660	5·52	11,285	10,238	58,105	5·68
94	Copper sulphate	Lb.	29,397,575	13,335	1,134,746	m85·10	27,057,860	12,273	922,673	m75·18
95	Crushed steel	Sh. T.	324	294	51,834	176·27	330	299	46,200	154·52
96	Graphite, artificial	Lb.	162,382	k73,655	10,149	k0·14	185,647	k84,209	11,693	k0·14
97	Lead, white, z	Lb.	105,804	95,988	9,522,360	99·20	93,172	84,525	9,391,738	111·11
98	Lead, red	Sh. T.	7,798	7,074	744,709	105·27	9,160	8,310	916,000	139·59
99	Lead, orange miner'	Sh. T.	477	433	76,320	176·26	541	491	108,200	220·37
100	Litharge	Sh. T.	8,591	7,794	773,190	99·20	7,460	6,768	710,192	104·93
101	Mineral wool	Sh. T.	5,617	5,096	61,494	12·07	6,560	5,951	70,314	11·82
102	Soda, manufact'ed. r	M. T.	.....	277,072	3,912,257	14·12	.....	340,632	4,080,651	11·98
103	Venetian red	Sh. T.	2,196	1,996	40,790	20·48	3,270	2,967	64,570	21·76
	Totals	.....	.....	.....	41,718,420	.....	.....	.....	49,432,829	.....

METALS PRODUCED FROM FOREIGN ORES AND BULLION. (*aa*)

Metals.	Customary Measure.	1897. Quantities. Customary Measure.	1897. Quantities. Kgm.	1897. Values.	1898. Quantities. Customary Measure.	1898. Quantities. Kgm.	1898. Values.
Copper	Pounds	26,938,254	12,219,112	$2,973,983	36,055,352	16,354,600	$4,247,320
Gold	Troy ozs.	584,983	18,195	12,091,599	1,065,552	33,142	22,034,960
Lead	Short tons	92,117	83,568,000	6,595,577	89,209	80,929,874	6,744,200
Nickel	Pounds	4,099,390	1,859,000	1,419,209	7,127,784	3,233,142	2,459,085
Silver	Troy ozs.	40,218,776	1,250,934	24,046,806	39,784,000	1,237,590	23,472,560
Total values	.....	.....	.....	$47,127,174	.....	.....	$58,948,125

REFERENCES.

In using the statistics in the foregoing tables, reference should also be made to the detailed tables under the respective captions further on in this volume, where many explanatory notes as to the statistics will be found. The following notes refer to the four preceding tables: *(a)* Except where otherwise specified. *(b)* Not enumerated. *(c)* Amount or value of crude mineral. *(d)* Partly estimated. *(e)* Estimated. *(f)* Amount recovered as a by-product. *(g)* Barrels of 300 lb. *(h)* Barrels of 400 lb. *(i)* Includes manganiferous iron ore; this is not duplicated in the report of iron ore. *(j)* Value per square, i.e., 100 sq. ft. lapped and laid; the weights are calculated on the basis 3 squares = 2,000 lb., but these figures are only approximately correct. *(k)* Kilograms or per kilogram. *(l)* Reduced to a basis of 66° B. *(m)* Average market price at New York. *(n)* Nominal. *(o)* Value before grinding. *(p)* Includes ocher, umber, sienna, and oxide of iron. *(q)* Includes salt used for the manufacture of alkali; the barrel of salt weighs 280 lbs. *(r)* Reduced to a basis of 58 per cent ash. *(s)* Includes a small amount made from spelter. *(t)* Average value of lake copper at New York, less 0.25c. per lb. *(u)* Includes spiegeleisen, though the total value is reckoned as if the whole product were ferromanganese. *(v)* Average market price at Pittsburg. *(w)* Troy oz. *(x)* Flasks of 76.5 lb. *(y)* Barrels of 42 gal. *(z)* Includes a comparatively small amount made directly from ores. *(aa)* Not included in the preceding tables.

Abbreviations: Sh. T., short tons (2,000 lb.), L. T., long tons (2,240 lb.); M. T., metric tons (2,204.6 lb.).

Columbia, and Joseph, of Liverpool, Eng. The late Mr. Killey was born in Castletown, Isle of Man, on April 24th, 1824. He studied in the Grammar School in that town, and received a general commercial education. He had had from his earliest years a great love for machinery. His parents purchased for him "Lardner on the Steam Engine," and this he mastered before he was 12 years old. At 14 he constructed a crude model engine and boiler, and so excited was he when it was nearing completion that he could not sleep for thinking of it. His parents about this time determined on sending him to Liverpool, to one of the large foundries there, and prepared him for the foundry business by sending him for a couple of years to cabinet-making. There was great difficulty in getting the position of apprentice at Liverpool, as many parents at that time wished to have their sons learn engineering. He eventually entered the Brunswick foundry, and ended his apprenticeship in the Vulcan iron works, then owned by a cousin of the late W. F. Gladstone. Mr. Killey afterwards became foreman of a large foundry and later mechanical manager and partner in the Windsor machine works, near Liverpool. The American war, however, interfered with business to such an extent that he left England with his brother and came to Canada in 1864. He obtained employment with F. G. Beckett & Co., Hamilton, and later was foreman of the St. Lawrence Foundry in Toronto. He repaired, while in this firm's employ, the steamer "Rothsay Castle," a blockade runner, which had been brought up from Halifax by Captain Leach, after she had run one season. He was appointed engineer of this boat, which position he held for three years, until the Fenian raids were threatened. He was then appointed engineer of the gun boat "Prince Albert," which was engaged in guarding the river and lake coasts. She took troops and munitions of war from Collingwood to Sault Ste. Marie during the first Red River rebellion. Mr. Killey left the boat to build an oscillating marine engine and boiler which he had designed for the composite steamer "Adelaide Horton." The engine was built in Hamilton and the hull in Goderich. After this engine was completed, Mr. Killey began business in 1870 in a small way in Hamilton, but it soon increased to an important industry. In 1884 the business became the Osborne-Killey Manufacturing Company, and turned out steam road rollers, boilers, engines, and sewer pipe machinery. Since the winding up of this company, Mr. Killey was associated for some time with the late F. G. Beckett, and latterly has been employed as a consulting engineer.

ONTARIO VOLUNTEER FIREMEN'S ASSOCIATION.

At a convention of the Ontario volunteer firemen, held August 31st, in Toronto, a permanent organization was formed, and the following officers were elected: R. C. Clarke, chief of Merritton, president; F. F. Earl, Milton, first vice president; J. H. G. Horey, Merritton, financial secretary; Dr. Creegan, of Thorold, corresponding secretary, and William Miller, of Smith's Falls, treasurer. Executive Committee: George

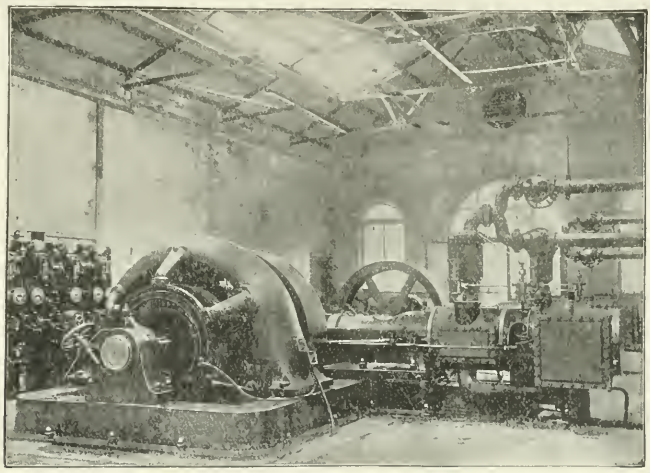
Johnston, Woodstock; Geo. Turner, Thorold; W. Smith, Trenton; A. Sargent, Toronto; and W. A. Thomas, Niagara Falls. Committee on By-laws: Riddell, St. Catharines; Skinner, Niagara Falls; J. H. Luscombe, Simcoe, and Tait, Alvinston. The next meeting will be held at Niagara Falls, Ont.

ISLE OF MAN TRAMWAYS.

The Isle of Man is the gem of the Irish Sea. It is only about 33 miles long and 12 miles wide, but every acre of its green, gorse-grown hills and rugged coast line is beautiful, and the quaint Manx language and customs which still survive make it doubly interesting to the visitor. It is situated almost in the centre between England, Ireland and Scotland, and being within easy reach, by swift steamers, of Manchester, Liverpool and Glasgow, has become a favored summer resort. Douglas, the principal town, situate on a beautiful bay, has a fixed population of about 30,000, which in summer rises to about 50,000. Every steamer from Liverpool, and other ports, of which there are several daily, bring hundreds who spend a few hours, days or weeks in this lovely spot. One of the chief attractions is the beautiful glens which indent the coast line, running up into the interior of the island between the hills. The Isle of Man Tramways Co., which operates an extensive system of cable and electric tramways in Douglas, has recently extended its electric line from Douglas to Ramsey, the next largest town in the island. The tramway runs around the precipitous cliffs overlooking the sea, skirting the beautiful Groudle, Laxey and Ballaglass glens. This drive, about 14 miles in length, winding in and out in full view of the sea, in an open electric car on a bright summer day, is very beautiful and most invigorating.

The recently completed extension of the I.O.M. tramways is a fine example of modern railway building and electrical construction. It is double tracked throughout, the roadbed is rock ballasted, and the bridges and culverts are of solid masonry. The over-head trolley is used, all the details of electric work being of the latest and best design and construction. Two large accumulator stations are used to equalize the load and assist the cars over the steep grades.

The motive power of the tramway is supplied from five power stations placed at various convenient points throughout the extensive system. The illustration represents the interior of the new power station at Ballaglass; it contains two 150 k.w. electric generators, manufactured by the Electric Construction Co., of Wolverhampton, England, directly connected to two 250 h.p. tandem compound condensing Robb-Armstrong engines, manufactured by the Robb Engineering Co., Amherst, N.S., Canada, for Dick, Kerr & Co., of London, who were contractors for the equipment. The station is also provided with two standard Galloway boilers and Ledwards electrically driven ejector condensers. Adjoining the power station is a large accumulator house, the whole making one of the most complete railway power houses in Great Britain. All the work of the Ramsey extension, including road-bed, electric lines and power stations, was done by the company's engineers.



Interior of Power Station, Ballaglass, I.O.M.

RAILWAY SUBSIDIES.

(Continued from last issue).

For a line of railway from Paspebiac, Quebec, to Gaspe, in the said province, not exceeding a distance of 82 miles.

Lake Erie and Detroit River Railway Company, for a line of railway from Ridgetown, Ont., to St. Thomas, a distance not exceeding 44 miles, this subsidy to be payable only in the event of adequate running rights over the Canada Southern Railway, between the two points above mentioned not being granted to the first-mentioned company on terms to be approved by the Railway Committee of the Privy Council.

Kingston and Pembroke Railway Company, for the construction of branches from the Company's main line to the iron mine at Bluff Point, and to the Martele mine, in the County of Renfrew, not exceeding five miles.

For a railway from Parry Sound extending northerly towards Sudbury, not exceeding a distance of 20 miles.

Resolved, That it is expedient to authorize the Governor-in-Council to grant the subsidies hereinafter mentioned toward the construction of the railways, also hereinafter mentioned, that is to say: The Ontario and Rainy River Railway Company, for a railway from Stanley station, on the Port Arthur, Duluth and Western Railway, to Fort Francis, for a distance of 140 miles, at $6,400 per mile, not exceeding in the whole $896,000.

To the Quebec Bridge Company, towards the construction of a railway bridge over the St. Lawrence river at Chaudiere Basin, near Quebec, one million dollars, payable 40 per cent., on monthly progress estimates approved by the Government engineers of materials delivered and work done.

To the South Shore Railway Company, towards the restoration and renewal of the railway bridge over the Yamaska river at Yamaska, Que., $50,000—Re-vote.

Towards the construction of a bridge over the Richelieu river at Sorel, 15 per cent., upon the amount expended thereon, not exceeding $35,000, re-vote, $35,000.

Towards the construction of a bridge across the St. Francis river, 15 per cent. of the amount expended thereon, not exceeding $50,000.

Towards the construction of a bridge across the Nicolet river, 15 per cent. upon the amount expended thereon, not exceeding $15,000.

To the Midland Railway Company, Limited, towards the construction of a bridge across the Shubenacadie river, 15

per cent. upon the amount expended thereon, not exceeding $33,750.

To the Great Northern Railway Company towards the construction of a bridge across the St. Maurice river, 15 per cent. upon the amount expended thereon, not exceeding $16,425.

Also towards the construction of a bridge across the Riviere du Loup, 15 per cent. upon the amount expended thereon, not exceeding $15,000.

Also towards the construction of a bridge across the Lac river, 15 per cent. upon the amount expended thereon, not exceeding $15,000.

Resolved, That the subsidies granted to the Ontario and Rainy River Railway Co., the Canadian Northern Railway Company and the Edmonton, Yukon and Pacific Railway Company, are granted upon the condition, and if received and paid under the authority of this Act, to the above-mentioned companies, respectively, shall be received upon the condition, that the said companies shall not, nor shall any of them, at any time amalgamate with any other railway company, or lease its line to any railway company; nor shall any of the said railways be leased to or operated by any other company; nor shall any of the said companies make an agreement for a common fund or for pooling its receipt with any other railway company, and any such lease, amalgamation or agreement shall be absolutely void, excepting in so far as such agreement may extend to traffic or running arrangements, which have been approved by the Governor-in-Council. Resolved, That the subsidies herein before mentioned, as to be granted to companies named for that purpose, shall, if granted to companies named for that purpose, shall, if granted by the Governor-in-Council, be granted to such companies respectively; the other subsidies may be granted to such companies as shall be approved by the Governor-in-Council, as having established to his satisfaction their ability to construct and complete the said railways respectively; all the lines for the construction of which subsidies are granted, unless they are already commenced, shall be commenced within two years from the first day of August next, and completed within a reasonable time, not to exceed four years from the said first day of August, to be fixed by order-in-council, and shall also be constructed according to description and specifications, and upon conditions to be approved by the Governor-in-Council, on the report of the Minister of Railways and Canals, and specified in an agreement to be made in each case by the company with the Government, which agreement the Government is hereby empowered to make; the location also of every such line of railways shall be subject to the approval of the Governor-in-Council. Resolved, That the granting of such subsidies, and the receipt thereof by the respective companies, shall be subject to condition that the Governor-in-Council may at all times provide and secure to other companies running powers, traffic arrangements and all other rights as will afford to all railways connecting with those subsidized, reasonable and proper facilities in exercising such running powers, fair and reasonable traffic arrangements with connecting companies, and equal mileage rates between all such connecting railways, and the Governor-in-Council shall have absolute control at all times over the rates and tolls to be levied and imposed by any of the companies, or upon any of the railways hereby subsidized. Resolved, That the said subsidies respectively shall be payable out of the consolidated revenue fund of Canada by instalments, on the completion of each section of the railway of not less than ten miles, proportionate to the value of the portion so completed in comparison with that of the whole work undertaken, to be established by the report of the said Minister, or upon the completion of the work subsidized, except as to subsidies with respect to which it is hereinbefore otherwise provided. Resolved, That every company receiving a subsidy under this Act shall each year furnish to the Government of Canada transportation for men, supplies, material and mails over the portion of its line in respect of which it may have received such subsidy, and whenever required shall furnish mail car properly equipped for such mail service, and such transportation and service shall be performed at such rates as may be agreed upon between the Minister of the department of the Government for which such service is being rendered, and the company performing the same, and in case of disagreement, then at such rates as may be approved by the Governor-in-Council, and in or towards payment for such charges the Government of Canada shall be credited by the company with a sum equal to three per centum per annum on the amount of subsidy received by the company under this Act.

THE INFLUENCE OF MECHANICAL DRAFT UPON THE ULTIMATE EFFICIENCY OF STEAM BOILERS.*

(Concluded from June issue).

RELATIVE COSTS.

2,800 NOMINAL H.P. PLANT, WITH CHIMNEY DRAFT.

2 additional boilers	$ 6,167
Settings, etc., for two boilers	1,250
Addition to building, etc	2,700
	$10,117

2,400 NOMINAL H.P. PLANT, WITH MECHANICAL DRAFT.

Fan, dampers and ducts	$ 1,500
Saving by using mechanical draft	8,617
	$10,117

Considering the matter of increased output solely in the light of comparative cost between the introduction of more boilers or the introduction of mechanical draft, and disregarding any possible cost of change in the chimney, we may again take for illustration the plant of 2,400 rated h.p. Suppose it is desired to increase its capacity to 2,800 h.p. or by 16 2-3 per cent. Then the relative costs under the two conditions will appear as here indicated.

We may now turn to that portion of our discussion which relates to the quantitative efficiency of a boiler plant. No greater waste occurs in modern steam boiler practice than that which is inherent in the employment of a chimney for the production of draft, namely, the loss of heat in the escaping gases. As the chimney depends for its action upon the maintenance of a temperature difference between the internal gases and the external air, it is manifest that with a chimney this waste can never be eliminated. It may be palliated, it is true, by the building of higher chimneys so that the same intensity of draft may be obtained with a lower stack temperature. But such means of providing for the utilization of the otherwise waste heat is expensive. In the case of a fan, however, the power expended as measured in heat units necessary to produce the same results, may, under ordinary conditions, be only abont one-seventy-fifth of that necessary with a chimney. In other words the fan renders available for utilization, practically all of the heat wasted by the chimney, while it possesses the further advantage of readily creating the additional draft required when heat abstracting devices are introduced. Donkin and Kennedy in seventeen independent boiler tests found the heat lost up the stack, when no economizer was used, to range between 9.4 per cent. and 31.8 per cent. of the total heat of combustion. As it is not practicable to cool the gases to atmospheric temperature it is evidently impossible to utilize all of the heat, but the ordinary economizer should, with mechanical draft, show a saving of between 10 and 20 per cent.

The importance of mechanical draft in the adoption of means for utilizing the waste heat, is well exemplified in the introduction of retarders and of ribbed tubes. Both of these increase the resistance and almost invariably require fan draft to enable them to create the saving of 5 to 10 per cent., which may be thus secured. The facility with which the intensity of the draft, and the volume of air supplied can be regulated when a fan is employed for draft production, has always been recognized as one of the most valuable characteristics of this method. Such regulations makes possible the most perfect distribution of the air, and its reduction to the minimum amount which will produce satisfactory combustion. For the mere chemical requirements of the combustion of one pound of ordinary coal, about 12 pounds or 150 cubic feet of air is required But under the conditions of chimney draft this amount is greatly exceeded. Donkin and Kennedy showed in the results of 16 tests that the air supply ranged from 16.1 pounds to 40.7 pounds.

*From a lecture by Walter B. Snow, before the Applied Science Graduate Society, McGill University.

As the gases pass onward through the tubes they become cooled, but those of higher temperature part most readily with their heat, and at the same time their volume and consequent velocity are reduced, still further facilitating heat transmission. On the other hand the gases of lower initial temperature transmit their heat less rapidly and the final result is that within practical limits the temperature of the escaping gases is least with the greatest excess of the air supply. The fact just presented points toward the economy to be secured by comparatively high rates of combustion, when the proper rate of heating surface to grate surface is provided. A high combustion rate manifestly requires a thicker fire, which in turn presents a better opportunity for contact between fuel and air with consequent economy in the supply of the latter. Less air results in a more intense fire, a higher furnace temperature, a greater transmission of heat to the water within the boiler, and a resultant higher evaporative efficiency. But a thicker fire requires a greater intensity of draft to overcome the increased resistance, while the relatively smaller area for passage of air necessitates a higher velocity of that air, and furthermore, the increased intensity to produce this velocity must be proportional to the square of the rate of flow. This condition is most readily met by the fan, which, under normal conditions, produces an intensity exceeding that of an ordinary chimney, and which can without trouble maintain the highest practicable rate of combustion.

The loss resulting from the formation of smoke is absolute, for it is equivalent to directly robbing the fire of a part of the fuel from which not only has no heating effect been secured, but upon which heat has actually been wasted in raising it to the temperature of the escaping flue gases. For the prevention of smoke, sharp, intense draft is necessary, properly regulated and capable of furnishing the required amount of air, both below and above the coal at the very moment when it is most needed. This result can be best secured by the introduction of mechanical draft which is ordinarily so regulated that the decrease in steam pressure resulting from the opening of the fire doors, the charging of the furnace, or the clearing of the fires, instantly causes an increase in the speed of the fan and in the intensity of the draft and the volume of air. A loss incidental to poor draft is that due to the formation of carbonic oxide. The formation of this gas instead of the complete product of combustion, carbonic acid, results from a lack of air. Sufficient air can best be secured by some means like the fan, which under automatic regulation increases both the intensity of the draft and the volume of the air when required. As a result, the pressure forces the air in sufficient quantity to all spaces between the fuel, and renders the combustion practically perfect.

By far the most important of the factors connected with the operating expense of a boiler plant is the cost of the fuel. When burned under suitable conditions, the decrease in its cost far outstrips its decrease in efficiency, so that the solution of the problem involves itself with the provision of the proper conditions. As a rule the cheap fuels, like the fine anthracites, require for their combustion an intensity of draft which the ordinary chimney is incapable of producing. The draft actually required under given conditions is clearly shown by these results of tests by Coxe:

RESULTS OF TESTS OF PEA AND BUCKWHEAT COAL.

Kind of Coal	Rate of combustion per square foot of grate per hour.	Pounds of water evaporated from and at 212° per pound of coal.	Air pressure in inches of water.	Maximum limit to size of coal in inches.
Oneida Pea Coal.	13.63	8.56	0.375	7-8
Oneida No. 1 Buckwheat	13.58	7.94	0.5	9-16
Oneida No. 2 Buckwheat	11.40	8.60	0.625	3-8
Oneida No. 3 Buckwheat	11.34	8.65	1.04	3-8
Eckley No. 3 Buckwheat	9.44	8.75	1.125	3-16

These coals, which are among the smallest in size, were burned on a special form of traveling grate, and the air pressure was maintained in the chamber beneath. It is noticeable that with practically constant combustion rate and evaporative efficiency, the draft increases very rapidly as the size of the coal decreases.

RELATIVE EFFICIENCIES OF VARIOUS COALS.

Kind of Coal	Water evaporated from and at 212° by one lb of Dry Coal.	Relative efficiency in p.c. Cumberland =100.	Cost of coal per ton	Fuel cost of evaporating 1,000 lbs. of water from and at 212°.	Relative efficiency in per cent measured by cost to evaporate 1,000 lbs. Cumberland = 100.
Cumberland	11.04	100	$3.75	$0.1698	100
Anthracite, broken...	9.79	89	4.50	0.2297	74
Anthracite, chestnut.	9.40	85	5.00	0.2660	64
Two parts Pea and Dust and one part Cumberland	9.38	85	2.58	0.1375	123
Two parts Pea and Dust and one part Culm	9.01	82	2.58	0.1432	119
Anthracite, Pea.....	8.86	80	4.00	0.2259	75
Nova Scotia Culm..	8.42	76	2.00	0.1187	156

The comparative efficiency of various coals as determined by Barrus is indicated in the accompanying table, which speaks for itself. The evidence in favor of burning low grade fuels is conclusive. Such results can, however, only be secured by positive and intense draft. It is true that as the quality of coal grows poorer and the size of the particles less, it becomes more necessary to provide some special form of grate or stoker for its proper burning. But even without an economizer to utilize the waste heat, the burning of cheap fuel by mechanical draft will, under perfect conditions, show a decided saving, after due allowance is made for fixed charges on the special furnace arrangements and for the cost of operating the fan:

Water evap. from and at 212° per lb. of coal.	ANNUAL SAVINGS RESULTING FROM BURNING CHEAP FUEL—COST PER TON.															
	$0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
11.00											4,892	3,669	2,446	1,223	0,000
10.50										5,474	4,193	2,912	1,630	349	
10.00									6,115	4,770	3,424	2,079	734		
9.50							8,240	6,823	5,407	3,991	2,575	1,159			
9.00						9,105	7,610	6,115	4,621	3,126	1,631	136			
8.50					10,074	8,491	6,909	5,326	3,743	2,160	578				
8.00				11,180	9,478	7,797	6,115	4,433	2,752	1,070					
7.50			12,393	10,509	8,805	7,012	5,218	3,424	1,630						
7.00	15,724	13,803	11,881	9,959	8,037	6,115	4,193	2,272	350						

The possible savings with low grade fuels and mechanical draft are still further evidenced by the accompanying tables, which show for a 1,000 h.p. plant, the annual saving, based on 312 days of 10 hours each, which would result from the substitution of a cheaper fuel for say Cumberland coal, costing, in round figures, $4 per ton, and evaporating 11 pounds of water from and at 212° per pound of coal. Under these conditions the annual fuel expense would be $19,568. If the assumption be made that a coal costing $2.50, and evaporating only 9 pounds of water is substituted, the annual saving would be $4,621. The cost of operating the fan even if the exhaust steam was not utilized, and it required 1½ per cent. of the total coal burned, would be only $224, and if this were charged against the saving it would still amount to $4,397, a sum sufficient to show a most

creditable reduction in operating expenses, even if there was also charged against it any additional labor and the fixed charges on a complete equipment of the special appliances for burning the lower grade fuel. A reduction of over $125 per week, equivalent to $6,500 per year, has been made in actual practice in the case of a boiler plant of 1,000 h.p., by the introduction of mechanical draft and the burning of yard screenings with a slight mixture of Cumberland.

Of the advantages of mechanical draft which are purely qualitative in their character much might be said, but time will not permit. It must suffice to merely refer to the more prominent points of advantage. When the fan is employed for draft production, the steel plate construction, the comparative lightness, the portable character and the absence of heavy foundations, render extremely simple its adaptation to the exact requirements. Being portable it is also salable, and hence an asset of real value as compared with the chimney. It may be used either for forced or induced draft, and placed where it will occupy no valuable space. It may be operated by direct-connected or belted engine or motor, and so proportioned as to produce any desired draft pressure. In operation, the fan is both positive and flexible, independent of the weather but capable of regulation to the finest degree, and of adjustment to the necessities of the fire at any particular moment. A mere increase in the cut-off of the fan engine brings about a result only secured with a chimney at the expense of adding to its height, while a change in the fan speed alters both the volume handled and the intensity of the draft produced.

If this discussion of the influence of mechanical draft on boiler efficiency has rendered clear the factors concerned, it has with equal force shown that this influence is beneficial—in many ways markedly so. In the light of this fact the present active interest in the subject points to the future general substitution of the fan for the chimney.

THE CANADIAN BICYCLE COMBINATION.

A combination has been effected, which includes four of the leading bicycle makers in Canada, the Massey-Harris Bicycle Co., H. A. Lozier & Company, Toronto; the Goold Bicycle Company, Brantford, and the Welland Vale Bicycle Company, St. Catharines. The leading members of the new firm are: Geo. A. Cox, Toronto; Warren Y. Soper, Ottawa; W. E. H. Massey, Toronto; E. R. Thomas, Toronto, and Hon. Lyman M. Jones, Toronto. The probability is that W. E. H. Massey will be president of the company. There will be a general head office in Toronto, but the manufacturing will be done at the places where the present plants of the different firms of the company are located. The company will be a joint stock company, with a capital of six million dollars, so that the concern will have ample capital in its business; it has cost now several millions of dollars to buy these firms out. The name of the new company has not yet been chosen, but at once will make application for incorporation, either by obtaining a provincial charter, or by making special application to the Dominion Parliament for the charter. This year the output of these four firms has been more than 30,000 wheels, and with such excellent plants will not be compelled to have a new one for the manufacture of the automobiles. The firms mentioned are the only ones who were asked to deal in the matter, and it is the intention of the company to employ the same men on each staff as are now in the employ of the several companies. The new company will also build autocars.

LITERARY NOTES

Fox and Melben, of 40 Taylor street, Springfield, Mass., U.S.A., have put a new nipple holder on the market. Some of the reasons why this "Fox" nipple holder should be used are given on a neat blotter, the title of which is "Ten Reasons," and parties interested in the cutting of pipe nipples, either plain, brass or nickel plated, should investigate this matter.

The Toronto Brass Manufacturing Co. issue a handsome 20 page catalogue, beautifully printed and illustrated, showing display stands in great variety, paper mache figures, etc. One of their specialties is the manufacture of brass hand railings for engine rooms, stair rails; one of their latest contracts called for 600 feet of brass railing 2½ inch diameter, for new hall in exhibition grounds, Toronto.

Catalogue No. 3 of the Toronto Electrical Works Co., Ltd., manufacturers of electrical supplies, has reached us. It is unique in its construction; perforated ends in the place of binding allow the insertion of new sheets illustrating new goods added from time to time, and also allow of the dropping out of discarded lines. A glance through shows the different lines to which they give prominence. They manufacture the "American Watchman's Time Detector," which won the only medal for its class awarded at the Chicago World's Fair. The "Toronto Time Register" is a new time check, and is of unique construction, and they claim that it is the only time register which will not allow errors to creep in through mistakes made by the time clerk. A complete line of electrical supplies and tools, pole and line fittings, telegraph instruments, battery motors, lamps, cord tips, electro-magnets, lightning arresters, blow lamps, long and short line telephones, etc., all of which are profusely illustrated and described. Catalogue sent on receipt of enquiry.

The past decade has witnessed a great advance in the art of catalogue making, particularly in the machinery trades. The modern catalogue must not only be attractive, and this seems to have been the sole idea in some recent publications, but it must above all serve in the best manner possible its primary purpose of furnishing information. Illustrations must be clear, explanations explicit, and all information concisely given. The substantial character of most machinery demands similar character in the make-up of the catalogue describing it. Bold, clear type, black ink, good cuts, simplicity in composition, and first-class paper of good weight, all have a subtle influence in impressing the reader with the idea of the high quality of the article described. An excellent example of good catalogue making, in which this is the controlling idea, is presented by the B. F. Sturtevant Co. Their publications are of two classes. First, those which are purely educational in their character, comprising treatises on various special applications of fan blowers, reprints of lectures on similar subjects, leaflets regarding the attendant advantages, etc. Second, the regular trade catalogues of the standard dimensions, 6½ inches by 9 inches, each devoted to a specific line of manufactured goods. Separate catalogues in the same class bear the same cover design, but are printed and bound in different colors with proper titles, so that they may be readily distinguished. All catalogues are designated by individual numbers, the latest being No. 110. The most recent products are immediately presented by bulletins (designated by letters), preliminary to the issuance of complete catalogues regarding the given machines. Loss of time is thereby avoided, and the new designs can be sooner placed before the public.

The Journal of the Western Society of Engineers for June contains some specially interesting papers as "Experiments to Determine the Effects of Freezing on Concrete," by W. A. Rodgers, and the "Preservation of Timber," by S. M. Rowe.

We are in receipt of a copy of the fifth edition of the Slide Rule, a practical manual by Chas. N. Pickworth, Wh. Sc., which is a valuable aid to the use of this necessary instrument.

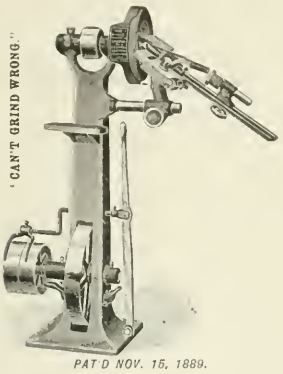
The Indicator Handbook is a practical manual for engineers, by Chas. N. Pickworth, editor of The Mechanical World. This book contains chapters devoted to the construction of the indicator, errors of the indicator, attachment of the indicator, indicator reducing gear, use and care of the indicator.

The new Canadian school songs have been composed for school celebrations by J. M. Harper, Ph.D., for many years rector of the Boys' High School, Quebec. They are "Hail to the Land," dedicated to Sir Wilfrid Laurier, and "Our Flag and Empire," dedicated to G. W. Ross, LL.D. The music is by F. C. Robinson and H. O'Connor Budden.

A feature of the National Export Exposition at Philadelphia will be an exhibit by the International Correspondence Schools, Scranton, Pa., illustrating their method of teaching by mail. The bound volumes of their instruction and question papers, as well as work done by students, including numerous drawing plates, will be shown.

THE YANKEE DRILL GRINDER.

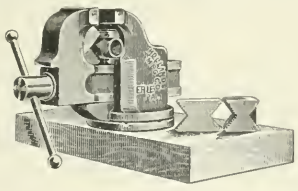
"Can't Grind Wrong." This suggestive heading has been used by the manufacturers of the Yankee Drill Grinder, with great success. As everyone knows that a twist drill badly ground will not bore true, nor will it bore a hole the exact size



of drill, it goes without saying that a grinder which does grind right is a great addition to any machine shop. The illustration printed herewith gives a good idea of the style of the machine. The Fairbanks Co. of Montreal is sales agent for Canada of this machine.

HOUGH'S EXTRA HEAVY COMBINATION PIPE VISE.

This combination vise is of inestimable value to engineers in mills, mining plants, steamboats, or to plumbers requiring a heavy vise. The makers claim that the castings used are of the highest grade, careful selection and the proper and intelligent mixing of the component materials, all tending to great strength. The workmanship is of the very best. The steel jaws firmly welded and finely tempered; the whole vise scientifically proportioned for strength and durability as well as convenience in use, and have no parts to get out of order. The particular vise illustrated is also fitted with reversible pipe jaws, giving prac-



tically two sets of jaws, as they can be turned end for end. Width of filing or plain jaws 4 inches; weight, 63 lbs. Swivel base, allowing the operator to work in any position, holds pipe from ⅛ to 2 inches, the larger vise holding ¼ to 3 inches. They also make a stationary base vise; capacity ½ to 4 inches.

The Hollands Manufacturing Co., of Erie, Pa., is not only vise manufacturer, but in their complete catalogue show planer chucks ranging from 6 inches to 30 inches capacity, "Acme" pipe tongs, Trimo & Stillson wrenches, roller and three-wheel pipe cutters, cutter wheels, pipe stocks and dies, also ratchet screw cutting stocks.

RAILWAY ENGINEERING.

Biggar, Samuel & Co.,

Gentlemen:—I received the copy of "Railway Engineering," by Prof. Smith, and while I was very pleased with the articles as they appeared in the "Canadian Engineer," I am more pleased with them in book form. I have read the book with interest, and often find it useful for reference, although I am not engaged in railroad work now. Wishing you success, I remain, yours truly,

F. W. Salmon.

Burlington, Iowa, August 6th.

Industrial Notes.

E. F. Munroe is building the new town hall in Windsor, N.S., at $8,286.

Macdonald Manufacturing Co., Stratford, Ont., is about to greatly enlarge its premises.

Jos. Orr, Stratford, Ont., furniture manufacturer, is installing a new Leonard engine.

J. S. Hogg is now manufacturing peat on the patented compression system near Galt, Ont.

Workman & Ward, London, Ont., iron founders and agricultural implement builders, are about to build new buildings.

Crescent Mill and Timber Co., London, Ont., is now completing its new factory, which is almost ready for the machinery.

W. W. Ogilvie will establish a 25,000 barrel mill and an elevator of 500,000 bushels capacity at Fort William, Ont., shortly.

R. S. Portuous, Stratford, Ont., is starting up a furniture factory for export trade in buildings formerly occupied by John Becker.

W. Partlo & Son are equipping the King mill at Ingersoll, Ont., as an oatmeal mill, and will put in new machinery, including steam plant.

The Toronto Cold Storage Co., Ltd., now has its plant in operation. The capacity is 80 tons per 24 hours, and is operated by a 150 h.p. engine.

J. W. and J. B. McManus, Memramcook, N.B., have a contract for Provincial Government on Tobique Narrows bridge substructure, and two highway roads.

Willis Chipman, who was the engineer for the Petrolia waterworks system, now has a similar position for the town of St. Mary's, where a $150,000 system is being put in.

J. W. Walters has started a machine and blacksmith shop in Dawson City, Yukon, and is going to turn out engines, boilers and mining machinery. During a recent visit to Montreal he bought supplies amounting to $30,000.

The shareholders of the Hamilton Steel & Iron Company have elected the following officers and directors: A. T. Wood, M.P., president; C. E. Doolittle, vice-president; A. E. Carpenter, C. S. Wilcox, John Milne, A. M. Wilcox and Wm. Southam. Robert Hobson is secretary.

The Massey-Harris Company is completing plans for the erection of a fine club house and library for the use of their employees on the north side of King street, opposite their premises in Toronto. The building, which will probably cost from $50,000 to $75,000, will include baths, reading room, library and social rooms, with a fine hall for public recitals.

Daniel and Ira Jacobs of Winona, Ont., narrowly escaped death, near Basingstoke, Ont., by the explosion of a traction boiler. The water tank became detached from the engine, and the Jacobs stepped down on the road to connect them. A few seconds later the boiler exploded, and scattered sections of the engine over the countryside; but, rather strangely, the Jacobs were not hurt in the slightest.

The Carter-Crume Company, check book manufacturers, Niagara Falls, N.Y., has been reorganized with a capital stock of $2,000,000. The new directors are: W. Caryl Ely of Buffalo, president of the International Traction Company; J. L. Morrison, S. J. Moore, W. E. H. Massey, president of the Massey-Harris Company of Toronto; J. W. Flavelle, president of the National Trust Company of Toronto, and Robert Kilgour, Toronto. S. J. Moore will be general manager.

The Fairbanks Company of Montreal has just furnished the Ontario Rolling Mills Co., of Hamilton, with an improved furnace charging scales of the suspension pattern. In this scale all the levers supporting the load are over head, thus leaving all the working parts free for inspection, and making them all the more durable. The scale has six beams to indicate the various required amounts of different material necessary for the proper composition of the product of the furnace. The scale is built of steel and iron throughout.

The income from Woodstock's waterworks this year amounts to $9,200.

A $35,000 waterworks by-law will be submitted to the ratepayers of Medicine Hat.

J. B. and J. W. McManus are to build the Burnt Church, N.B., wharf at $13,000.

The Hamilton, Ont., Bridge Co., is to build the Appleton, Ont., bridge; price, $2,500.

R. Grant, contractor, Toronto, is building the waterworks dam, London, Ont., at $40,000.

Hunter Bros., Kincardine, Ont., have finished the bridge over the Grand River at Elora, Ont.

Campbell Reeves, Montreal, has bought a controlling interest in the Canadian Locomotive works at Kingston, Ont.

The business of the Tingley & Stewart Manufacturing Co., Toronto, rubber stamps, dies, etc., has been bought by Bernard Cairns.

Willis Chipman, C.E., is superintending the construction of waterworks for St. Mary's, Ont., for which the council recently appropriated $25,000.

Leamington, Ont., has a tax rate this year of 15 mills. The town owns the water and gas plants, and the profits from these permit of this low rate.

C. W. Cadwell, of the Cadwell Silex Stone Co., has been appointed by the Amherstburg, Ont., Quarry Co. to take charge of the whole quarry output.

The Goldie-McCulloch Co. has recently been given an order for $4,000 worth of sugar making machinery by a company doing business in the city of Mexico.

The contract for supply of lumber and timber for the construction of the Dominion Iron and Steel Co.'s works at Sydney, C. B., has been awarded to A. F. Bury Austin, Montreal.

The Montreal Rolling Mills Co., has secured a site comprising about sixteen acres from the Dominion Iron and Steel Company, near the southern boundary of their works at Sydney, Cape Breton.

McManus and Lowe, contractors, of Halifax, N.S., have the contract for the foundations of the works of the Dominion Iron and Steel Co. at Sydney, C.B., the price being $150,000. Two years will be required to complete the plant.

The drilling of artesian wells for the Waterloo, Ont., waterworks by Leaper Bros., of Hawkesville, Ont., has been successful, as not only is the flow abundant, but the water is of excellent quality. The supply from the three wells sunk will be in the neighborhood of 750,000 gallons in 24 hours, at least five times the quantity consumed at the present time.

The Trent Valley Peat Fuel Co., Peterborough, Ont., has placed an order with the F. D. Cummer & Son Co., Cleveland, O., for a Cummer Dryer. The dryer will be used for drying peat preparatory for pressing into briquettes. The dryer will have capacity for evaporating 2½ tons of water hourly from the wet peat, which would give about 60 tons of dried peat per day of 24 hours.

A prophet is not without honor, etc. The aphorism would seem to apply to City Engineer Jones, who visited London, by invitation, a short time ago, to advise the aldermen how to stop damage from flood in West London, while Brantford city council consults a Hamilton engineer to devise means to prevent West Brantford from being flooded.—Brantford Expositor.

The Alberta Railway and Coal Co., Lethbridge, N.W.T., has ordered two 150 h.p. Mumford improved boilers from the Robb Engineering Co. It has had three of them in use for about a year, and this order speaks well for the satisfaction they have given. The makers of these boilers claim they are more efficient than any other type in use, while they cost less than a water tube boiler.

The Hamilton Bridge Works Company is rushed with orders, and is said to have work enough ahead for eighteen months to come. Its premises are too limited to permit of increasing its facilities on the site now occupied, but negotiations are proceeding through R. Maclay, for a five acre site in the northeastern part of Hamilton, Ont., where a considerable extension of the works would be made.

The Revelstoke, B.C., council has appointed S. L. Saunders chief of the fire brigade at a salary of $80 per month for the balance of 1899. The council will establish an electric fire alarm system at an estimated cost of $600.

Frederic Duclos, plumber, 78a Inspector street, Montreal, has assigned at the instance of the Star Iron Company, with liabilities of about $25,000. The chief creditors are: Dame F. Duclos, $9,000; Royal Institution for the Advancement of Learning, mortgage, $8,700; Walter Andrews, mortgage, $3,500; D. Nicholson & Co., $1,333; Star Iron Co., $859; A. Prudhomme et Frere, $614; T. H. Goulet, $520; Chas. Depocas, $600; J. Douglas, $500; S. A. Phillips, mortgage, $1,250.

The Maritime Stove Foundry Association was in session early in August in St. John, N.B. Halifax, Yarmouth, Moncton, Sackville, Amherst and St. John makers were present. A satisfactory agreement as to prices of hollow ware was reached. It was determined to increase the price of repair castings to six cents per pound and to increase the price of stoves and other foundry products five per cent., the change to take effect at once. A resolution was adopted urging retailers to form local associations to overcome the evil of price cutting.

The Hoepfner Refining Company, Ltd., Hamilton, Ont., has been granted letters of incorporation. Carl Hoepfner, of Frankfort-on-the-Main, Germany, doctor of philosophy, is at the head of the undertaking. The company purpose "to mine smelt, refine, manufacture and sell zinc, lead, copper, nickel and other metals." The share capital of the company is placed at $600,000. The provisional directors are Messrs. Carl Hoepfner, David Maclaren, Ottawa; Andrew T. Wood, John M. Gibson, John Moodie and John Patterson, Hamilton, and Nathaniel Dyment, of Barrie.

The McEachren Heating and Ventilating Co. had a very prominent exhibit of their fans, blowers and valves at the Toronto Exhibition. One feature was a handsomely decorated 24-inch fan in operation. There was a stock of blowers ranging from 30 inches to 90 inches in diameter; a boiler feed pump, and samples of the firm's new back pressure valve, ranging from 2 inches to 6 inches, and which can be used on either horizontal or vertical pipe. The firm's hot water heater "Little Wonder," was also shown in the stove building. This firm has the contract for the heating and ventilating plant of Prince of Wales College at Charlottetown, and the P.E.I. hospital of the same city. The 90-inch steel-plated fan shown at the Exhibition has been sold to the Granby Rubber Co., to be used for drying rubber.

Electric Flashes.

D. F. Whidden has bought out the Antigonish, N.S., electric light works.

The Kay Electric Motor Company has assigned to Sheriff Middleton, Hamilton.

At a recent directors' meeting the Royal Electric Co. declared a quarterly dividend of 2 per cent.

The electric light building at Wolfville, N.S., which was destroyed by fire a short time ago, will be rebuilt at once.

A project to put in an electric street railway will probably come before the Chatham, Ont., council in the near future.

The electric plant at Petty Harbor, Nfld., is now under construction. A head of 200 feet is being made available.

The Rossland Sentinel has installed in its printing establishment one of the Royal Electric Co.'s S.K.C. two-phase motors to drive the presses.

A project is mooted to connect the various small towns along the Rideau canal and lakes by means of a trolley line. A very large water power is available at Jones' Falls, Ont.

Frenyear and Batmeyer of the Westinghouse Electric Co., Buffalo, and E. Baxter, Fort Erie, Ont., propose to build an electric line from Fort Erie to Chippewa, Ont.

It is said that the Royal Electric Co., of Toronto, has made application for a franchise for an electric railway between Barrie and Allandale, a distance of about a mile.

T. W. Clark, Bridgewater, N.S., has the contract for constructing a power house, wheel pit, conduit and tail race at Milton, N.S., for Liverpool's electric light system, at $2,750.

The several companies that control the pulp mills, the electric plant and water mains, the carbide and iron works at Sault Ste. Marie, Ont., have been consolidated and capitalized at $6 000.000.

It is stated that the two electric companies of St. Hyacinthe, Que., may soon pass into the hands of M. Dubrocard, Lyons, France. It is said that the price to be paid is in the vicinity of $175.000.

The name of the Cataract Power Company of Hamilton has been changed to the Hamilton Electric Light & Cataract Power Company, and the capital is permitted to be increased from $250,000 to $3,750,000.

An action for $10,000 damages has been entered against the Royal Electric Company by J. Cyr, father of the boy who was killed on St. Louis street, Montreal, a few weeks ago while trying to catch a bird on the branch of a tree.

We understand that the Cleveland Seed Co., Picton, Ont., has placed an order with the Royal Electric Co. for a complete electric lighting plant for its warehouse. The dynamo is of 200 light capacity, and about 100 lights wired up.

The city of Hamilton has received $3,789.55 in street railway percentage for the last three months. The city of Toronto has received $12,721.03 from the same source for the month of July alone. The city of London has just paid out $3,400 for militia expenses on street railway account.—London Advertiser.

J. C. Clark, Ayr, Ont., is promoting an electric railway from Berlin to Port Dover, Ont. No bonus is asked, only the right of way through the towns. The road starting from Berlin is to pass through Waterloo, Ayr, Paris, Brantford, Boston, Waterford and Simcoe, to its terminus at Port Dover.

A number of the electrical men employed by the Electric Light & Power Company and Bell Telephone Company met at the Victoria Hotel, Hamilton, Ont., and discussed the advisability of forming a local branch of the International Electrical Association. Another meeting will be held shortly, when the electrical workers, including linemen, etc., may organize.

The Central Manufacturing Co., Chattanooga, Tenn., has furnished materials for the power plant at Ogden, Utah, U.S., and the plant of the Telluride Power Co., Salt Lake City, U.S. The Central Manufacturing Co. makes a specialty of yellow pine cross-arms, oak and locust insulators, pins and brackets.

The Renfrew Electric Light Company is being organized with a proposed capital of $50,000, of which about one-half has been already subscribed. The new company will embrace at least one of the existing electric lighting companies, and will undertake to supply power as well as light. It is an outcome of the development of the water power of the Bonnechere river, at Renfrew.

Thos. Vaughan, a young man employed in the Royal Electric Co.'s works, Montreal, was seriously injured, August 30th. He was working at one of the dynamos, and turned the wrong switch, with the result that he received a current of 10,000 volts. He fell unconscious, but when taken to the hospital revived, and is recovering.

Users of electric lights in Parrsboro, N.S., pay 19 cents for 10, and 30 cents for 16 candle power, with an all night service. Until lately, although the streets are well lighted with 28 arc lights, enough profit was made out of the incandescent services at the prices charged to pay for the street lighting, which in many towns would cost between two and three thousand dollars.

At a recent meeting of the directors of the Lachine Rapids Hydraulic and Land Company the statement of the company's business for the half year ending June 30 was very satisfactory, showing a gain of a hundred per cent. over the corresponding period last year. The directors declared a half-yearly dividend of 2 per cent. on the paid-up stock of $1,250,000. This dividend was earned after paying 6 per cent. interest on $600,000 worth of bonds. It was also stated that W. Davis & Son, contractors, had been paid in full; and that satisfactory progress was being made at the new works.

The Hamilton street railway has been taken over by a syndicate representing the Cataract Power Co., composed of Hon. J. M. Gibson, J. Dickenson, J. Moodie, Hamilton, and J. A. Kammerer, Toronto.

The Aptus Veneer Company, Albert, N.B., has placed an order with the Royal Electric Co. for a complete electric lighting plant for its works, the plant to be in operation within four weeks of date of order.

Bennett Bros., who own and operate a flour mill at the corner of Parke and Market streets, Hamilton, Ont., are installing in their premises a 40 h.p. S.N.C. motor to drive their mill, power being supplied by the Cataract Power Co.

The Willson Carbide Works Co. has orders much in excess of its capacity. When the new works at Ottawa are completed the company expects to be better able to keep up with this enormous and growing demand for calcium carbide.

Work has been begun on the development of the Shawenegan Water and Power Co.'s plant at Shawenegan Falls, Quebec, and is being pushed night and day. The Royal Electric Co. has installed for the contractors one of their 15-light T.H. arc machines and lamps, lighting the entire work.

The Hamilton screw works of the city of Hamilton are another of the converts to electric power, having shut down their steam plant, and are now being supplied with power from the wires of the Cataract Power Co. The Royal Electric Co., of Montreal, is installing a 40 h.p. S.K.C. two-phase motor. This adds another smokeless chimney to the many now in Hamilton.

Henry T. Duck, Toronto, of the Engineering Contract Company of New York, has just been awarded a contract by the Canadian Electric Light Company of Quebec for a large concrete dam, with sluiceway and bulkheads, the foundations of power house, supports for flume pipes, tail race, etc., at the Chandiere Falls. The contracts for the power house, the hydraulic and electric machinery and the transmission line will be awarded in a short time, and it is expected that the company will have power to dispose of in this city within some nine months. T. Pringle & Son, of Montreal, are the engineers in charge.

Liverpool, N.S., is installing a complete electric plant to furnish arc and incandescent lights for the streets, and incandescent lights for indoor use. The by-law was voted on some time ago, and an order has been given to the Royal Electric Co. for a complete electrical equipment, consisting of one 75 k.w. S.N.C. two-phase alternating current generator, with exciter and switchboard complete, also a complete switchboard and regulating apparatus for twenty-five 2,000 C.P. enclosed alternating arc lamps for the streets, as well as the necessary transformers and materials for installing 2,000 incandescent lamps, the whole plant to be in operation within six weeks.

Contracts have been let for the construction of a building to be temporarily occupied by the Edgerton Storage Battery Company, Hamilton, Ont. The building will be 75 by 125 feet, one story high. As soon as the building is in running shape another building will be erected for a main factory, and this one will be used as a storehouse. It is said the company will shortly be capitalized at about half a million dollars, and has work now ahead sufficient to guarantee its success. It is the intention of the company to use the Hamilton works for its export business. The zinc that will be used in the construction of the batteries will be supplied by the Hoepfner Refining Company.

The new steam plant power house of the Metropolitan Street Railway Co. at Bond Lake, has been equipped by the Goldie & McCulloch Co., of Galt. There are two cross compound condensing Wheelock engines, 17½ inches and 32 inches by 42 inches, and supplying 1,000 h.p. The fly-wheels are 18 feet diameter and 44 inches face. There is a battery of four boilers, each 73 inches diameter and 16 feet long. The electrical equipment is of the Westinghouse type, the order having been placed with W. A. Johnson, under whose superintendence the plant was installed. There are two 275 k.w. generators at Bond Lake, and two 250 k.w. generators at the sub-station at York Mills. The plant is arranged so that alternating and direct current can be used interchangeably.

One man was instantly killed and another seriously injured by coming in contact with a live electric wire at Sherbrooke, Que., August 26th. Louis Benoit, whose home is near Waterloo, Que., was killed, and Simeon Roy, of Sherbrooke, seriously injured. They were in the employ of the Gas and Water Company, and had been instructed to remove a certain arc lamp. Not having a crank to the windlass by which the lamps are lowered, Roy took hold of the cable which runs up the pole, and to which the lamp is suspended. In lowering the lamp in this way he pulled this wire to one side, and it came in contact with the electric light wire above. When he felt the shock he shouted to Benoit to cut the wire. The latter seized his pliers in one hand and with the other grasped the deadly wire above the place where Roy held it. The result was that the full current of 2,000 volts passed through Benoit, and Roy, who held the wire lower down, was relieved and fell to the ground unconscious, but alive. Benoit was dead before help reached him. Roy will recover.

Railway Matters.

The C.A.R. train between Montreal and Ottawa, Ont., jumped the track August 9th and seven persons, including the engineer, were killed.

Two locomotives for the Quebec & Central Railway are being built at the Kingston Locomotive Works. The boilers for these two were tested recently.

The Hull City Council has decided to give H. J. Beemer a $30,000 bonus towards the erection of railway shops, etc., in Hull. A by-law will be submitted to the people.

C. R. Reid is building the stations on the Coast Railway, N.S., at Lower East Pubnico, Wood's Harbor, Upper Wood's Harbor, Shag Harbor, and Barrington Passage.

In anticipation of an extraordinarily large grain crop in the North-West and Manitoba, the C.P.R. has this season added 2,000 box cars, making 6,500 available for handling the present crop.

E. Berryman, C.E., has completed the exploration survey of the Atlantic & Lake Superior Railway Company, between Port Daniel and Gaspe Basin. The railway will reach Gaspe Basin by the valley of the York river.

A new station building at Rat Portage, and a twenty-stall roundhouse with turntable, for the Canadian Pacific Railway, together with rock excavation for extension of tracks to company's yards at Rat Portage, is now going on.

It is said that after many months of surveying and the expenditure of much money, the C.P.R. engineers have at last discovered a feasible route for a railway over the divide between the Kettle and Okanagan River valleys, and to the south of Camp McKinney.

Wm. Mackenzie has closed contracts in five-mile sections of the Rainy River railway with John C. O'Neill, of Kemptville; John R. Turnbull, Winnipeg; McGillivray and Gleeson, Hugh Mann, and Luke Madigan, aggregating fifty-five miles to be finished before winter sets in. John R. Turnbull also received a contract for building all bridges and trestles between Stanley and Fort William.

Notice is hereby given that an application will be made to the Parliament of Canada, at the next session, for an act to incorporate a company under the name of the Deutsche Klondeik Gesellschaft to construct a railway from Dawson City in the Yukon Territory, along Bonanza Creek and across the Dome to Dominion Creek, covering a distance of about fifty five miles, with power to build branch lines, etc.

A horse and carriage containing five passengers made a trial trip across the new Victoria Jubilee bridge last month from the Montreal side, and returned. The occupants of the carriage were G. B. Reeve, general traffic manager; F. H. McGuigan, general superintendent; J. M. Herbert, superintendent of the eastern division, R. P. Dalton, superintendent of Montreal terminal, and F. H. McGuigan, son of the general superintendent.

The mammoth new round house of the Grand Trunk Railroad at Sarnia has been turned over to the company. It is one of the finest of the kind on the Grand Trunk System. The round-house, which is situated about a half mile west of the depot, is built of white brick, with stone foundation and gravel roof. The total length is about 760 feet, the depth 76 feet, and the height 20 feet. There are 30 engine stalls, each accommodating one locomotive. The foundation of these stalls is composed of four feet of brick, and two feet of cement. They have been thoroughly tested and have proved entirely satisfactory to the company's inspector. In addition to the round-house proper, there has been constructed an office and machine shop building, 56 feet by 32 feet, and a 70-foot turntable.

Mining Matters.

A single crystal, weighing over half a ton, was taken from the Tett Bros'. mica mine, near Westport, Ont., recently.

T. B. Caldwell has sold his iron mine at Calabogie, on the K. & P. railway, to the Hamilton Steel & Iron Co., Limited, Hamilton.

George E. Vickers, vice-president and manager of the Canadian-American Oil and Natural Gas Co., is boring for oil near Belleville, Ont.

Natural gas has been discovered at Clarkson, between Toronto and Oakville, Ont. But as yet the quantity available has not been determined.

The British Columbia Southern Mine, Ltd., operating the Gertrude mine in Rossland, B.C., has ordered a complete lighting plant from the Royal Electric Co.

A rich find of free gold is reported as having been made near Wabigoon, Ont., north of Dinoric, in the neighborhood of Lake Minnistuttle, by Jos. Bouston, a prospector.

Nichols & Son, of New York, have secured an option on the George McIlraith iron mining property on the fourth concession of Darling, Lanark County, Ont., and will develop it in the next few months.

It is reported that a large vein of copper has been discovered, extending from White Horse Rapids, on the Yukon, to a point on the Dalton trail forty miles from the Lynn canal. It is said to be exceedingly rich.

Near Cascade, on the Columbia and Western railroad, which the Canadian Pacific is building from Rossland into the Boundary Creek district, McKenzie & Mann, contractors, have discovered ore, running high in copper, gold and silver. Assays have shown as high as $50 to the ton.

The Coleraine Chrome Mining Company has been incorporated with an authorized capital of $300,000, and headquarters at Montreal. The incorporators are: Hanson and Ferguson, brokers; R. Wilson Smith, Hon. A. A. Thibaudeau, W. E. Blumhart and Honore Favreau, Montreal, and Hon. A. Desiardins, Maisonneuve.

Paul Johnson, M.E., a graduate of the Royal Technical High School and Mining Academy, of Stockholm, Sweden, is to superintend the building of the smelter of the British Columbia Copper Smelting Co., at Greenwood, B.C., together with John Norborn, of the Union Iron Works, San Francisco, which company has the contract for the iron work.

The Sultana mine, Lake of the Woods, has been sold by J. F. Caldwell, the sole owner, to an English company for $750,000. The mine comprises about 70 acres, with a vein about 30 feet wide on the surface, and running about $7 to the ton in gold. Its gross output for three years, with a ten stamp mill, averaging $3,000 per week, and with the thirty stamp mill put in last fall the earnings have been at the rate of $151,000 per year.

James P. Howley, F.G.S., geologist to the Government of Newfoundland, has recently presented an official report on the mineral exports of the colony from 1888 to 1898, inclusive which will shortly be published. In regard to the copper ore Mr. Howley gives a list of figures showing the export of

copper each year from 1888 to 1898; the value of which he finds to be $5,907,638. The value of iron pyrites, mainly shipped from Pilley's Island, during the same period, was $1,522,250. Chrome iron was shipped to the value of $70,890, mainly from Port-au-Port. The value of iron ore shipped from 1895 to 1898 was $200,140. The total value of all minerals exported, 1888—98, was $7,829,158. Of slate, $1,350 worth was shipped in 1898, and of the last-named article Mr. Howley states that some of our deposits are equal in quality to the best Carnarvon slate in England, and better than any used in the United States. Of the petroleum wells at Port-au-Port, Parsons' Pond and other places, Mr. Howley speaks in favorable terms. Indications of petroleum have been found over large areas on the west coast.

Personal.

S. S. Glass has been appointed to the charge of the electrical and steam plant in the Victoria Hospital, London, Ont.

E. I. Sifton, manager of the Electrical Construction Company, London, Ont., was married a short time ago in that city to Miss Kate Kelley.

J. J. York, engineer, in charge of the plant in the Board of Trade Building, Montreal, has resigned, and accepted a similar position in the St. Lawrence Sugar Refinery.

Arch. Rankin, marine architect, who formerly practised in Toronto, and is now chief architect to the American Shipbuilding Co., a combination of shipping interests recently effected at Cleveland, was recently in Toronto on a visit.

J. A. Calder, of Halifax, N.S., and member of the well-known firm of Wm. Muir & Sons, spent a day in Toronto on his way west. Mr. Calder was taking estimates for a cornmeal plant he proposes to install at Dartmouth, N.S.

H. P. Archibald, engineer, formerly of Antigonish, N.S., has been appointed superintendent of the Lethbridge, N.W.T., Waterworks & Electric Light Co., Ltd., and has now taken over the charge of these works.

W. A. Peck, representing the O. W. Bullock Co., of Springfield, Mass., was in Toronto for a few days last month. Mr. Peck is a well posted traveller, and has been engaged in the tool supply trade for some years past.

W. B. McLean, a graduate of McGill College, Montreal, for the last three months employed in the drafting room of the Robb Engineering Co., Amherst, N.S., will continue his technical studies in Manchester, England.

John Bosence, locomotive fireman, Fairville, N.B., was seriously injured in a very unusual way. The water glass on the boiler exploded and the shattered tube flew, one piece striking with great force in the young man's back, entering on the right side near the border of the shoulder blade, penetrating right through the right lung and then striking a rib.

Archibald McBride, Kingston, Ont., died after a short illness August 6th. He came from Ireland 60 years ago with his parents, settled in Kingston, and has lived here ever since. During that time he was continuously employed by the Richelieu & Ontario Navigation Company, as engineer, serving on all their boats. His last boat was the "Corsican," on which he was working till within three weeks of his death. He was a brother of Robert McBride, engineer on the R. & O. steamer "Bohemian," and Samuel McBride, carpenter at the Royal Military College, Kingston.

Four of a gang of 16 men engaged in laying the foundation of a pier of the Midland railway bridge across the Shubenacadie river, Nova Scotia, were drowned August 20th in a caisson sunk to the bottom of the river. It was supposed to be air tight, the pressure of air from a plant on the shore keeping the water out. Through some blunder the safety valves were opened and the air rushed out, and the water rushed in to take its place. The men scrambled for the ladder in the narrow air shaft. Twelve ascended in safety and four perished in the rising flood. Their names were Luke Peters, James Wilkes, William Donegan and James Donahoe, of New York.

William Power, a veteran shipbuilder, died in Kingston, Ont., August 29th, after a prolonged illness. He was 78 years of age, and was born in Prince Edward Island. He was engaged in shipbuilding at Quebec, Montreal and Kingston, and many famous craft were of his handiwork.

Three research scholarships of £150 a year, tenable for two years, have been granted by the Exhibition of 1851 Commissioners to W. B. McLean, McGill University. Scholarships have been continued for a second year to W. G. Smeaton, Toronto University, and E. H. Archibald, Dalhousie University, Halifax.

W. F. Pike, M.A., Ph.D., for twenty years professor of chemistry at Toronto University, has resigned, and will remove shortly to England, where he has purchased an estate. He had a private mechanical laboratory, which he equipped at an expense of about $20,000, which was acknowledged to be the most perfectly appointed machine shop in Toronto.

While raising one of the trusses for the roof of the new Methodist church building at Fergus, Ont., John Moffat, contractor for the woodwork, was almost instantly killed. The truss was being hoisted with block and tackle, and was almost at the required height when one of the guy-ropes broke. Mr. Moffat saw what had happened, and was running to avoid the falling timber, when he was struck between the shoulders and died almost immediately.

Marine News.

P. Griffith, St. James street, St. John, N.B., boat builder, has received an order from the Fishery Department, Ottawa, to build a 20 foot gasoline launch, for use at the biological station, St. Andrew's, N.B.

A despatch from Halifax, N.S., states that the barque "Strathome," Maitland, N.S., now at Cork, Ireland, has been sold on foreign account for $14,000. She was built in 1883, and is 1,098 tons register. This is said to be the fifth large Nova Scotian ship sold within a month to Italians. Within the past twelve months there has been a demand for wooden ships of this class, and prices have advanced materially.

There is considerable speculation going on in marine circles over the rumor from Ogdensburg that in all probability the five large steamers of the Ogdensburg line will be made passenger boats by the opening of next season. Plans, it is said, have already been approved of. This, if it goes into effect, will give Chicago direct communication with the lower lakes.

The Allan Line steamship "Sicilian" has been launched. The "Sicilian" is of 5,000 tons, and is especially intended for freight service, but will have accommodation for about 60 first cabin as well as for a number of steerage passengers.

The Lake Erie Navigation Co., Ltd., $40,000 capital, has been incorporated by E. C. Walker, Walkerville; F. H. Walker and J. H. Walker, Detroit; S. A. King, M.D., Kingsville, Ont.; W. Woollatt, Walkerville.

The item in the estimates of $350,000 for Port Colborne is "on account." The plan now in the department contemplates, the Minister of Public Works states, not only the deepening of the harbor, but the erection of berths and slips for the mooring of ships as well as the construction of breakwaters.

At a meeting a short time ago of the promoters of the Quebec, Hamilton & Fort William Navigation Company it was understood that R. A. Lucas, Hamilton, Ont., would take the place of the late Senator Sanford as one of the incorporators of the company. It is the intention to have two new boats built this year, in readiness for next spring's business.

The R. & O. Navigation Co. made a service test of the speed and coal consumption of the new steamer "Toronto" the other day. The builder's guarantee was a speed of 17 miles per hour on a consumption of 2 lbs. of coal per h.p. per hour. On the test made she attained an average speed of 17 1-3 miles per hour on a consumption of 1.76 lbs. of coal per h.p. It is said that the best record hitherto made by a side-wheel steamer having a triple expansion engine, and showing a like speed, is a consumption of 1.80 lbs.

FIRES OF THE MONTH.

August 1st. Electric light plant, Wolfville, N.S.; damage, $8,000.——August 14th. Monty's planing mill, Roxton Pond, near Granby, Que.; damage, $15,000; insurance, $4,500.——August 14th. Monson & Boright's saw-mill, Magog, Quebec; damages, $5,000; insurance, $1,000.——August 14th. James Robson & Son's tannery, Oshawa, Ont.; loss, $4,500.——August 18th. St. Ferdinand d'Halifax, Que., convent of the Sisters of Charity; damage, $50,000.——August 20th. Ontario Box Co., Hamilton, Ont.; damage, $40,000.——August 24th. Scarfe & Co., Brantford, varnish factory; damaged slightly.——September 5th. Power house of the Niagara Falls Park & River Railway; loss on plant, $75,000; building, $10,000.

THE ASPHALT BLOCK.

BY C. BAILLAIRGE, C.E.

The new asphalt block pavement, so-called, is new to Canada, though known and used in a few places in the United States for some time. It is now being laid along the Grande Allee, or St. Louis road, Quebec, extending from the Gate to De Salaberry street, a run of 3,700 feet; and the width being 47 feet from curb to curb. The area, including crossings, will be some 20,000 yards, which at 25 bricks to the yard (the blocks being 12 x 4 x 4 inches), will require half a million blocks. The writer was not slow to recommend their use; as, before he ever heard of them, he had urged on the city council in his yearly reports, an addition of grit or crushed quartz to the powdered rock asphalt, to suit it to grades where the ordinary sheet asphalt would be dangerous. An English engineer named Livingstone had also, after an exhaustive visit to United States, reported favorably on the use of the asphalt block; his report appearing at length in The London Surveyor, an engineering journal highly thought of by the profession.

The asphalt block we are using is made at Hastings on the Hudson, some 30 miles from New York, by the Hastings Paving Company, 66 Broad street, New York. The block or brick, as it may be called, is made up of some 87 to 90 per cent. of crushed quartz, granite or trap rock, reduced to the consistency of coarse sand or fine gravel, in a matrix or binding mixture of Trinidad asphalt, heated to a temperature of 250° to 300° F., the two thoroughly mixed and forced into and out of steel moulds several inches in thickness to stand the stress, under a pressure of 5,000 lbs. to the square inch. This statement is exact, the writer having visited the company's premises and witnessed the process; while he also saw the paving being laid by the company at 183rd street, New York.

There is no doubt but what the mixture of gritty matter with the asphalt or bitumen is the only thing capable of rendering the material suitable to certain grades of roadway. A portion of 183rd street, New York, falling towards the Hudson, has a grade of nearly 1 in 7 or 8, and will, I believe, prove to be too abrupt a one for such material; granite setts being better adapted to such inclines as in Mountain, Palace, Canotterie, Dambourges and Genevieve street hills, Quebec. Neither is the scoria brick suited to such slopes, as witness the upper portion of Mountain Hill, Quebec, where against the written opinion of the city engineer, they were laid, instead of continuing the stone paving to the north side of the electric railway track, at the corner of the postoffice and presbytery, where the outer rail at curve had to be laid to grade of inner rail at least, and should be even higher to guard against derailment by centrifugal action.

The paving on Grande Allee is laid on a bed of sand about half an inch thick or more, overlying a foundation of 5 inches of concrete. This is laid on the old bottom on which the tamarack blocks were laid some 12 years ago. This foundation is composed of two thicknesses of inch boards at right angles, each to the other. The boards are still in a sound state of preservation, as wood generally remains when removed from atmospheric influences, and especially when in or under water, or in wet or moist soils; while wood laid in dry sand or loam does not endure beyond a few years comparatively. I should have preferred, nevertheless, having the wood removed and replaced by so much concrete; but the extra cost would have been some 25 to 30 cents a yard or more and reasons of economy prevailed, as it was held that the boards having already stood good for twelve years would hold out indefinitely; timber underlying old macadam having been taken up in other parts of the city, which had been there for over 50 years, and still as sound and clear of discoloration as the day it was laid.

The 4-inch concrete, as stated, was laid direct on the wooden flooring, where the height of the electric track allowed of no intermediate material; but where the rails are laid at a higher level to rectify grade of roadway, the concrete is laid on a 2 to 3 inch bed of broken stone—that is, of the old macadam picked from between the tracks and rails and spread over the boards, after removal of the old wooden block pavement—the portion thereof occupied by the tracks having been taken up two years ago, when they were laid, and the levelling made up of broken stone.

And just here it may be well to state with regard to the life of a wooden pavement of round tamarack blocks, that while that laid on the Grande Allee, twelve years ago, as stated, was found to be in a dilapidated condition from dry rot, blocks are now to be found in the sample room, city engineer's office, city hall, Quebec, which on the occasion of laying water and drainage in Couillard street, were taken up after being there for more than thirty years, and which though worn down by traffic some 2 to 3 inches, or whole height of block reduced from 8 to 6 and 5 inches, were found to be, and are to this day as perfectly sound as when laid some fifty years ago. The reason for this is that the Couillard street blocks were cut and laid green, or with the sap in them, and which under the influence of moisture from rain and the subsoil retained their sap, keeping the wood green and wet, and thus preventing dry rot; whereas, due to the grub epidemic of 1885 to 1889, the worm feeding on the needle of the tree, killed the tamarack, and this sapless wood being used on the Grande Allee instead of the live material, decay set in and dry rot ensued. The life of a wooden pavement is quoted at only seven years, except when creosoted or infiltrated with some antiseptic, while I had in my sample room, already mentioned, specimens of Australian hard woods, "Tallow" wood, "Mahogany," "Blue Gum" and Jarrah, which to test their comparative endurance under similar circumstances of traffic and exposure, were laid in one and the same street at Sydney. They were taken up after being there eleven years, and show only from ⅜ to ⅝ of an inch reduction in height during the interval, and are still absolutely sound to the very heart, though slightly discolored.

Returning now to the asphalt block, which may either be laid on a bed of sand overlying the concrete, as stated, or preferably on a coating of half an inch of cement mortar; the blocks are laid close jointed, and are well fed to the layers, at the rate of 10 to 15 yards per man per hour (100 to 150 yards per day of 10 hours), but exclusive of closers along curb stone, which require another man or two to cut them to length and lay. The overlap of the brick as laid in New York is 4 inches (1-3 of the whole block), and thus the opposite joints occur at only every third course; but as laid here, the lap is 6 inches (half of the block), the joints thus breaking at every second or intermediate course instead of at every third, engineers differing as to which is preferable. The whole is intelligently carried on under the foremanship of — Watson of New Haven, on recommendation to E. Parent, the contractor, by the Hastings Company. The next operation is ramming down, which is done by two men with a heavy beetle (some 90 lbs.), while a third drags a half-inch plate of steel about 10 inches wide and a foot and a half long, thus always embracing more than a brick in length and two in width, and this is moved backwards and forwards along the pavement in a way always to overlap the last portion receiving the impact or the already consolidated surface.

Following this is the sanding of the joints; for though the blocks are said to touch, there are always interstices of 1-16 to ⅛ of an inch due to roughness of surface, which allows fine dry sand to percolate the joint and fill it. This sand filling was a matter of anxiety to me, as I feared that during rainy weather water might get at the foundation layer of sand and cause the blocks to settle; but no such settlement has occurred anywhere, even after a continuous and heavy two days rain. This non-percolation of surface water into the joints between the bricks I attribute to the bricks' antipathy for water, the oily and greasy nature of the bitumen being antagonistic; or may be water percolates the broader of the joints to a certain depth only, due

to the repulsion referred to, and then acts as a bridge over which the rain water passes on and down the roadway.

When thoroughly sanded, or supposed to be, to all appearances, the paving is opened to traffic. Then a slight tremor of the bricks causes the sand to settle in the joints and the sanding process is repeated to satiety; the sand requiring to be screened fine and absolutely dry (sun or fire dried), without which it will not run into the narrower interstices. It is said, though I was not long enough in New York to notice the thing, that under traffic the edges or arris of the brick gives, due to its plastic nature, and that thus the joint becomes filled in and absolutely impermeable to water.

The cost of the blocks is some $80 per 1,000, delivered at the mill or factory. Thus for transportation to Canada, some $2 per ton has to be added for freight, or $17 per 1,000, the blocks weighing about 8½ tons to the thousand. Again, there is 20 per cent. duty to pay, a toll at Rouses' Point of say $1 to $1.50 per large load, wharfage, harbour dues, etc., cartage to site of paving at say 100 blocks or 4 yards sup., per cart load (1,700 to 1,800 lbs. with us). Now add taking up and removing old pavement, grading, levelling, concreting, sand foundation and laying, and a minimum is arrived at, allowing 10 per cent. profit, of about $3.37 per yard sup. of finished paving; while the tenders for the work ranged up to $4.27 per yard.

Certain precautions are to be observed in the delivery or rather before delivery, or until the blocks have sufficiently cooled down to allow of handling, piling and rough usage in barging and unloading. The bricks to prevent sticking or adhering should be sanded between the layers, and especially on board the barge, where during the hot weather of July and August, and due to superincumbent weight, they are liable to cling together, but can be easily separated with the chisel and hammer. I have also found some of the blocks (very few) to be slightly curved, as if under pressure of overlying load, urged to hug the curved outline of the containing vessel.

The blocks, to save handling and hauling, are piled along the sidewalks on either side. It requires about three or four laborers, according to width of street, to keep the pavers or layers supplied. The brick cuts well, and square, and easily under a blow or two of the hammer, with a chisel 4 inches wide on edge, or wide enough to cover the whole breadth of block.

Between the track rails a row or course of bricks is first laid longitudinally within the rail on each side. This border course is laid to enter an inch, or as far as it will go under the upper flange or projecting head of the rail; tilting it the while to about the camber required (a quarter of an inch), when four stretches just fills the remaining space between the opposite border courses, and the underlying sand bed is, by the use of a mold or template run along the track, resting upon the rails, cambered up in a way to cause the paving between the rails to crown at level, or a quarter or half inch over it, as may be desired; while the border courses so tilted and put in under the top of rail afford the space necessary for the car wheel flange to run in; and again, the sloped groove or depression thus left along the rail, instead of being square, which would catch and hold the wheels of vehicles, allow the wheel to move out sideways without, as in the case of the square groove, tending to haul the paving after it.

Where the fish plates and connecting wires occur (at every 30 feet or length of rail), some of the border bricks inside the rail have to be cut longitudinally, which is easily and neatly done by jumping the chisel along the brick, back and forth, as in splitting a stone parallel to its length, or along the line of proposed fracture.

When the roadway is double tracked, the space between the tracks is filled in flush with top of rail, or, as outside the tracks, a quarter of an inch higher to allow of settling by ramming and under traffic; and as laid here, it takes just three and a half bricks or stretches to reach from rail to rail. This space is also cambered up by a sand template to half an inch additional above the concrete; as any pavement laid flat always looks hollow, and any such hollow in a roadway looks as bad as would a hollow floor or deck, instancing at the same time a want of forethought by the engineer or architect against settlement. To ensure uniformity of curve or camber in cross section of roadway from the curb to curb or curb to rail, when the paving goes on along one side of the street, while the other remains open to traffic, the best, easiest and quickest mode is to measure down from a line held taut across the roadway and resting on curb and curb or curb and rail. It requires two hands to hold the line, but where only one is available, the string at one end can be tied to a peg or to a brick left hanging in rear of curb stone, or in rear of rail before the track is paved or sidewalk laid. This line is successively held at distances of 3 to 4 feet along the roadway—when ordinates or vertical offsets are measured down from it to level of top of concrete—the ordinate along the rail being 4½ inches, or the thickness of the brick plus that of the sand-bed (less, if you wish, a quarter of an inch to allow for settlement by ramming and traffic); at or along the curb, the ordinate is say 9 to 10 inches, including depth of paving and height of curb there; over half way or thereabout (the eye will do) between these extreme points another or third offset is taken, and two more, a fourth and fifth at points again half way (by eye) between the others.

To regulate height or level of pegs to be driven for top of concrete, Mr. Watson has an ingenious mode of offsetting by means of a stick with a notch in it at 4½ inches from level of string, one at 9 inches, and three others at intermediate heights as required and calculated in advance, or measured from a template cut to camber of roadway. He then sets and drives his peg home, or until the top of it is just at proper level to suit offset. These five offsets have of course to be repeated for as many pegs on the other side of the roadway, when in turn that side is being paved, and the paved side handed over to traffic.

To form the sand-bed, strips or templates ½-inch thick are laid at distances along the road of 8 to 10 feet; when two men, one at each end of a straight edge, move it and the sand with it along the templates in a direction parallel to rail and curb and back and forth until the sand is worked down to proper level. I had omitted to say that the paver or layer, instead of, as usual, standing on the unpaved portion, keeps on the portion already laid; as standing on the sand-bed when prepared as above stated would altogether jeopardize the regularity of the work.

This asphalt block pavement is certainly an improvement on the sheet asphalt as far as durability is concerned, it being 4 inches thick, while the sheet is but one to one and a quarter inch. Again, the grit in it suits it to ordinary grades where the sheet would prove slippery and dangerous. Neither will this asphalt block be suitable for heavy traffic or for quick or steep grades or inclines, where nothing but granite setts should be used. The sheet has been laid, against my advice, in such narrow and trafficy streets as St. Paul and St. Peter, Quebec, where on account of wheels travelling constantly in same line, the asphalt will soon be worn into ruts and hollows. The sheet is suitable for residential streets, and especially where there are no rails, as in some of the streets at Westmount, Montreal, where, after, they say, nine years laid, it shows no sign of failure; but in St. James, Notre Dame and other streets, where the traffic is comparatively heavy and tracks exist, the asphalt begins to give a quarter of an inch at a time along the rails under the erosive action of the wheels of vehicles, and then it goes on crumbling, a fraction of an inch at a time, until wide ruts are formed, which have to be repaired.

The Hastings Company also manufacture hexagonal blocks for sidewalks. They make them about 2¼ to 2½ inches thick, which is too heavy and expensive. I have advised the company to reduce these to 1¾ inch, or even 1½ inch, as sufficiently thick to stand foot passenger traffic for years to come. We are about laying a quantity of sidewalks in Quebec with these, which on account of the greater measure of grit in them will prove preferable to the "mastic," as laid hot and rolled or smoothed with wooden pallets. The latter becomes somewhat disagreeable to walk on during hot weather, and especially while the sun shines hot upon it, when it almost instantaneously softens to the consistency of putty or of soft or kneaded clay puddle, and the foot actually sinks into it, perceptibly, or say a sixteenth of an inch or so, though it immediately hardens again the moment the sun is obscured.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain of interest to the metal trades in July, 1898-99, and the seven months ending July, 1898 and 1899:—

	Month of July.		Seven Months to July.	
	1898.	1899.	1898.	1899.
Hardware	£2,190	£1,695	£12,502	£11,145
Cutlery	11,301	3,497	30,798	29 617
Pig iron	928	2,023	7,086	7,072
Bar, etc.	383	2,373	6,042	8,089
Railroad	—	36,533	6,972	57,228
Hoops, sheets, etc.	7,772	16,620	24,027	55,455
Galvanized sheets	8,236	5,071	32,071	35,474
Tin plates	11,946	20,997	83 598	98,091
Cast, wrought, etc., iron	1,839	6,877	15,208	24,412
Old (for re-manufacture)	499	344	3,574	2,003
Steel	5,001	13,079	32,643	43,626
Lead	4,126	5,860	16,058	27,329
Tin, unwrought	1,550	2,925	11,223	12,442
Alkali	3,547	2,056	24,419	18,658
Cement	2,270	3,534	12,153	16,236

SAND FILTRATION OF PUBLIC WATER SUPPLIES.*

BY R. S. LEA, ASSOC. M. CAN. SOC. C. E.

(Continued from last issue).

The layer of gravel serves to support the sand and to conduct the water horizontally to the under-drains. The excessive thickness used in some of the old filter beds is not at all necessary, 12 or 15 inches being quite sufficient. It should consist of three or four layers of graduated sizes, the top one being fine enough to support the sand without any liability of the layers getting mixed. Around the openings into the underdrains the separate stones should be carefully placed so as to avoid any possibility of movement when the water begins to flow. If necessary the gravel must be thoroughly washed before being put in place.

In arranging the underdrainage system of a filter, which includes the gravel bed, the object to be aimed at is to cause the water to sink vertically through the sand, and as nearly as possible at a uniform rate in all parts of the bed. In order to effect this it is evident that the resistance to horizontal motion in the underdraining system must be everywhere nearly the same. Attempts have been made to calculate the proper size of the underdrains, using formulae for the flow of water through gravel and sand of various sizes. A discussion of the matter will be found in the Report of the Mass. State Board of Health for 1892, and also in Allen Hazen's book on the "Filtration of Public Water Supplies," pp. 32-41. With round tile drains, and a daily filtration rate of 2.57 million gallons per acre, Mr. Hazen suggests the following limits to the area which pipes of the different sizes should be allowed to drain:

Diam. of drain.	To drain an area not exceeding	Corresponding velocity of water in drain.
4 inches	290 square feet.	0.30 ft. per sec.
6 inches	750 square feet.	0.35 ft. per sec.
8 inches	1,530 square feet.	0.40 ft. per sec.
10 inches	2,780 square feet.	0.46 ft. per sec.
12 inches	4,400 square feet.	0.51 ft. per sec.

and a cross-sectional area for the larger and main drains of at least 1-6000 of the area drained. With the rate mentioned this would give a maximum velocity in the drain of 0.55 feet per second. These underdrains are variously constructed of open jointed channels of stone or brickwork, or of tile pipes with perforations or open joints. There is no advantage in spacing the laterals more than about 16 feet apart, as the extra quantity of coarse gravel necessary would cost more than the saving in the pipe. In some filters the underdraining has been accomplished by means of a double bottom of open brickwork supported on arches or other arrangements of the same material. The lateral drains usually rest upon the bottom of the basin, but the main drain is often placed lower. If the top of the drain is higher than the coarsest layer of gravel, that part should be closed to prevent the entrance of the fine gravel. In several of the old filters vertical ventilating pipes extend from the under drain above the surface of the water on the bed. These are for the purpose of allowing the escape of air from below, so as not to cause disturbance by passing through the sand. They are not used in the latest filters, as it was found that they were of no advantage, but rather a source of trouble, through the formation of channels between them and the sand, which allowed water to pass without filtration.

The basin which encloses the filtering materials must of course be water-tight; and in that respect the same care must be experienced in its design and construction as would be necessary in the case of any reservoir for holding water. Its depth will depend upon the thickness of the bed and the height to which the water is to be allowed to rise, but does not usually exceed 10 or 12 feet. The bottom is usually level, or perhaps with slight depression for the lateral drains. The walls may be either vertical or sloping, depending upon the material used. Taking into account the necessity of uniformity in the filtration rate at different points of the bed, vertical sides are probably preferable to sloping. Local circumstances will as a rule, determine the best method of construction and the material to be used. The latter may include stone masonry, brick, concrete, earth embankments, puddle, etc. Concrete is a very satisfactory, and in most cases an economical material to use for any part of the structure.

If a roof is required it should consist of groined arches, supported on pillars, preferably of brick. Care is necessary to obtain a solid foundation for the latter, as the form of roof will not admit of much unequal settlement. A good plan is to form the bottom of flat inverted arches, which will give a firm and even support for all the pillars; and the lateral underdrains will then lie along the hollows midway between the rows of piers. With a roof of this kind, vertical side walls will be more economical than sloping ones. But the plane surface between the wall and the bed must be broken by projections, in order to prevent the liability of unfiltered water passing along the junction; which remark also applies to the piers. It is to prevent this same contingency that the gravel layer is only carried to within 2 or 3 feet of the walls, its place being filled by the sand which here composes the whole depth of the bed. Around the inlet and outlet chambers there should be no gravel within 5 or 6 feet of the walls.

Manholes must be constructed in the roof for the admission of light and air. Also a "run" for entering and removing the sand scrapings, etc. With piers spaced 14 or 16 feet on centres a light and strong roof can be built of concrete at a very moderate cost. When the roof is finished it is covered to a depth of two or three feet with earth surmounted by a layer of loam, which may be seeded down or laid out in flower beds, etc. For open filters the sides may be of earth embankments, made water-tight by a layer of puddle or concrete. If of the former, a paving of brick is necessary, which must be of sufficient strength to withstand the action of the ice where it is exposed.

Before proceeding with the methods of operating a filtration plant we will discuss it with reference to these important features, the inlet, outlet, underdrains, etc. With a given flow of water through the bed, the vertical distance H represents the head required to force this quantity through the surface film, the sand, gravel and underdrains. It is variously termed "loss of head," "head on the filter," "filtering head." The depth of water in the majority of European filter beds is usually from 3 to 4 feet, with the full depth of sand. In some of these filters it was allowed to rise and fall according to fluctuations in the removal of the effluent. Such variations in depth, however, are found to have an injurious effect upon the surface layer, and on the efficiency of the filtering process; in the newer plants, therefore, they are provided against by an apparatus on the mouth of the inlet pipe, by which the water when it reaches a certain height automatically closes the inlet. These consist usually of some form of balanced valve worked by a float. In connection with an open filter, such an arrangement must be protected from frost. The inlet opens into a small chamber at the side of the bed, from which it is separated by a wall. The water flows over the wall on to the bed, and is prevented from disturbing the surface of the sand by paving it for a short distance from the chamber. Sometimes the water enters by overflowing an open masonry channel extending across the surface of the bed. The loss of head, corresponding to a given rate of flow of water through the filter, will depend upon the extent to which the surface film has formed, and the friction in

*From a paper read before the Canadian Society of Civil Engineers.

the sand, gravel and underdrains; but under any given conditions it varies (within practical limits) directly as the rate. In some of the old filters, the outlet was connected directly to a clear water basin, or pump well; and the difference in level between the surface of the water in the filter and of that in the well was, of course, equal to the loss of head. Fluctuations in the draft upon the well produced corresponding fluctuations in the filtering head, and therefore in the rate, which was thus automatically adjusted to the demand. In others, however, some sort of apparatus was placed between the filter and the clear water basin by which the rate could be kept constant. This is now considered to be of the greatest importance for the reason that bacterial tests of the effluents have shown that marked deterioration invariably follows fluctuation in the rates. This is probably caused by the mechanical disturbances produced in the sand-bed and surface film. For details of such tests, see Report Mass. State Board of Health for 1894.

In the newest plants, therefore, some kind of an arrangement is always provided for the regulation of the flow. Since the rate varies directly as the loss of head, it is immaterial which is regulated. Some of these devices, therefore, regulate the flow directly, while others accomplish the same result by the indirect method of regulating the loss of head. In order that the former may be kept the same from one day to another, the latter must be gradually increased as the period of service of the bed extends, so as to correspond with the increasing resistance of the surface layer. This is effected automatically in the device which was designed by Lindley for the filters at Warsaw. The apparatus is contained in a water-tight chamber, connected on one side with the filter, and on the other with the clear water basin. The rate at which the water can pass from one to the other depends upon the depth to which the slits in the sliding pipe extend beneath the surface of the water. This is adjusted by weights at the other end of the chain which passes over a pulley. Thus the rate can be kept constant; and as the resistance of the bed increases the level of the water in the chamber will automatically adjust itself to produce the necessary differences in level or loss of head.

In the method of regulation devised by Gill for the Tege works of the Berlin water supply, the outlet from the middle chamber is through a weir; and the depth of water on its crest, and, therefore, the discharge, is indicated by the height of the float read on the scale. This is kept constant by means of the gate. The corresponding loss of head is shown by the difference of the readings on another scale. Keeping the water in the filter always at the same level, a constant rate can only be maintained by the gradual falling of the level in the right hand chamber and a consequent wider opening of the gate.

As to the limit beyond which the loss of head should not be allowed to go, the general opinion seems to be that it should not be greater than the depth of water on the bed, though the Lawrence experiments have not shown any bad effects from exceeding this limit. As a general thing it may be stated that, everything else being equal, the higher the rate the poorer the quality of the filtrate. But with fairly low rates this deterioration is slight, so that entirely satisfactory results can be obtained with rates up to 3 or 3½ million gallons per acre per day. Probably higher rates could be safely employed if very great care were exercised in the operation of the filter. The relative effects of high and low rates from a financial point of view are discussed further on.

When the clogging of the filter bed has become such as to require a loss of head greater than the prescribed limit, the inlet is closed and the water allowed to drain away until it has sunk some distance below the surface of the sand. When this has become sufficiently firm, workmen enter the bed with planks wheelbarrows and broad flat shovels. With these they carefully remove the suraice layer and pile it up in little heaps, which they afterwards remove with the barrows. The depth removed varies from ½ to 1 inch, and averages about 8-10 of an inch. The surface of the sand is then raked to loosen up the packing caused by the boots of the workmen, and after smoothing down any irregularities the planks are removed and the filter is ready for another period of service. The refilling begins from below by admitting through the underdrains filtered water from another bed in action. The object of this is to drive out the air from the pores of the sand, where its presence in the form of bubbles would cause considerable unnecessary friction. When the water has risen a few inches above the surface of the sand, the lower connection is shut off, and the refilling is completed by means of the surface inlet. Before filtration proper begins the water should be allowed to stand on the bed for several hours; or the first million gallons or so should be wasted. The amount wasted can be reduced by beginning the filtration at a low rate, and gradually increasing it to the maximum. When the scrapings have reduced the sand-bed to the minimum allowable thickness, the total amount removed, which has in the meantime been thoroughly washed, is replaced at one time. Before doing so the surface of the permanent layer, which is never removed, should be loosened up by being spaded over to a depth of six inches or so. If this is not done, there is a liability of sub-surface clogging at its junction with the clean sand. When the filter is started again, it is, except for the permanent layer, in the condition of a new filter, and so requires extra care in operating it, and the filtrate should be wasted for a much longer time than is required after the scrapings. Piefke of the Berlin waterworks places this period at six days. Considering the labor necessary, and the time the bed is out of use, this replacing of the sand is an expensive operation, and should not occur oftener than can be avoided. In most plants the usual period is about once a year.

Sometimes it is possible to obtain new clean sand at less cost than is necessary to wash the old. But this is rarely the case; hence an important part of the equipment of a fair-sized filtration plant is the apparatus for the washing of the sand. The simplest of the methods employed for this purpose consists of a broad shallow box, which is set in an inclined position. The dirty sand is thrown into this box, and a jet of water played upon it from a hose. The water overflows from the lower end of the box and carries the dirt with it. This is continued until the water runs off clean. The more elaborate methods employ mechanical means to force the water through the sand. Drum-washers, operated by horse or steam power, are largely used in Germany. They are set in an inclined position, and the sand, with streams of water playing upon it, is forced from the lower to the upper end by means of revolving spiral blades. Various other methods more or less on the same principle are employed.

The "Ejector" washer is probably the most efficient of all the methods employed. It consists of a series of conical hoppers arranged in a row. At the bottom of each hopper is an ejector through which a stream of water passes under a pressure of 15 or 20 lbs. The dirty sand is thrown into the first and largest hopper. From this it is ejected through a vertical pipe into a trough, from which it falls into the next hopper. Here the same thing occurs; and the process is repeated until the water, which is continually overflowing from the hoppers, comes off clear. The whole arrangement must be enclosed in a masonry pit, from which the dirty water is conducted by drains. Six or eight hoppers are required for each machine, which will have a capacity of from 5 to 6 cubic yards per hour. Sand washers of this type are used in the new filters at Hamburg, and are to be used in the plant now under construction at Albany, N.Y. Details of the latter are given in Engineering News, February 10, 1898. The volume of water required in sand-washing varies, according to the method used, from 12 to 20 times that of the sand; the ejector machines apparently requiring the most. The question of cost will be referred to under maintenance.

(to be continued).

The annual summer class in practical surveying in connection with the faculties of applied science of McGill University, began September 1 Carillon, P.Q., is the headquarters of the class this year, and here a series of practical surveys of prospective railways and a continuation of the partial survey of the Ottawa river are being carried out. Upwards of forty-five students, who intend entering upon the courses of architecture, mining, and civil and electrical engineering, are attending the class, which will continue until the session of the Faculty of Applied Science opens. C. H. McLeod, professor of surveying and geodesy; J. G. G. Kerry, lecturer in surveying, and R. S. Lea, assistant professor of civil engineering, are in charge of the work of the class.

Price Bros. & Co.'s saw mill at Amqui, Que., was burned down Sept. 5. The loss will amount to about $100,000.

Abraham Leyer, contractor, of Montreal, has assigned at the instance of Ovid E. Galarneau, with liabilities of about $20,000.

Bylaws to raise $18,000 for a new central school and to raise $4,000 to extend the waterworks system were both carried in Owen Sound recently.

The industries at Deseronto, Ont., are in a very flourishing condition, both the cement works and the new charcoal iron smelter being ordered many months in advance.

Darling & Pearson, architects, Toronto, have been asked to prepare plans for a large hotel in Muskoka, Ont. This hotel will accommodate 500 people. Hamilton capitalists are interested.

The flour mill and shingle mill of Mills Bros., Merrickville, Ont., was destroyed by fire Sept. 5th. The flour and oatmeal mill belonging to H. Easton was also burned, and Watchorn & Co.'s woolen mill was damaged.

Inspectors Noxon and Christie, and Architect Heakes of the Ontario Government staff, are preparing plans for the reconstruction of the Penetanguishene Reformatory into an asylum. The Government has decided to build a new reformatory in Oxford county.

A bylaw was passed at Vancouver, B.C., recently, giving council power to raise a loan of $150,000 for the purpose of extending and improving the city sewage system. At the same time a bylaw to raise a loan of $20,000 for the purpose of acquiring certain lands fronting on English Bay for a public bathing beach and recreation grounds was lost.

The city of Winnipeg has decided to purchase a softening plant for its new waterworks, the plant to cost $17,430 and the installation work $12,500, or a total of about $30,000. The Pittsburg Testing Laboratory, Pittsburg, Pennsylvania, has been awarded the contract for the plant by the fire, water and light committee subject to the approval of the council.

The Ottawa Electric Company has forwarded to Ald. Campbell, acting Chairman of the Civic Railway and Lighting Committee, the following letter, which sets forth the liabilities which the city will have to assume in case of its purchasing the entire plant and equipment of the company: "In compliance with your request I beg to submit the following to enable you to arrive at the amount that the city would be required to assume to take over the business, franchises, etc., of this company, as set forth in our letter of April 27th last. I might add that the figures are taken from our statement of April 30th last, the date of last closing of books:—Capital stock, fully paid up, $765,000; debentures bearing interest at 5 per cent., $320,000; accounts owing, bills payable, $155,940.41; total, $1,241,740.41. I might further add with reference to the item of $155,940.41, that this is about offset by such assets as accounts due to the company, merchandise, stores, etc., on hand. Trusting that this information is satisfactory. (Signed) D. R. Street, Secretary-Treasurer."

WANTED—Young man familiar with installing and repairing electric recording meters. Give particulars of experience. Only hustlers and first-class penmen need apply. Advancement if satisfactory. Address "WATT," Canadian Engineer, Montreal.

WANTED—A First-class Mining Foreman, who has had experience in Galena, Zinc and Silver Mining. Send references and rate of wages expected to P. W. RESSEMAN, 31 Central Chambers, Ottawa, Ont.

FOR SALE

A good Water Power, 500 horse, situated one-half mile from railway, every facility for making siding to power. Address
J. D. THEUNISSON, Cookshire, Que.

—Dr. Andrew MacMeans, of Mexico, a native of Toronto, and a graduate of Trinity University, was in the city recently, spending a few days. Chatting with a Toronto World reporter, Dr. MacMeans said: "I paid my first visit to Mexico ten years ago, and was highly pleased with the progress that country was making, in fact my expectations were surpassed. The vast improvement Mexico has made in the last quarter of a century is almost phenomenal. Twenty years ago there was hardly a railroad, to-day the country possesses over 12,000 miles, and 18 miles of street railway. He further states that the exports of Mexico are the imports of Canada, and the imports of Mexico are the exports of Canada. There is a very great hatred in Mexico for the United States, and everything coming from that country and Canada should profit by this.

—The discovery of the extent and importance of the hematite or limonite deposits in the Michipicoten district seems to promise an enormous development in the iron smelting industry of Ontario. A realization of the immense area and valuable nature of the deposits has been obtained by the receipt of a 43 lb. sample of brown hematite at the Bureau of Mines, accompanied by an explanatory letter from Prof. A. P. Coleman, Provincial Geologist, who has been spending some time in the Michipicoten region. The ore specimen in question contains 60 per cent. of iron, and it was taken from a deposit on the claim of Mr. E. V. Clergue, of Sault Ste. Marie, which is about ten miles north of Michipicoten Post.

ACETYLENE... THE FUTURE LIGHT

THE PERFECT LIGHT for Public Buildings, Offices, Stores and Dwellings.

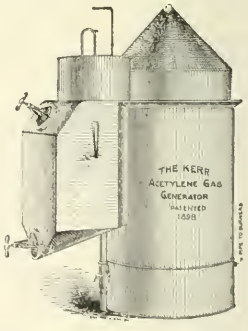
The Kerr Acetylene Generator

Patented in Canada, Great Britain, United States, France and Germany. Other Canadian and foreign patents pending.
The only perfect apparatus for the generation of Acetylene Gas from Calcium Carbide. Neat, compact and durable.

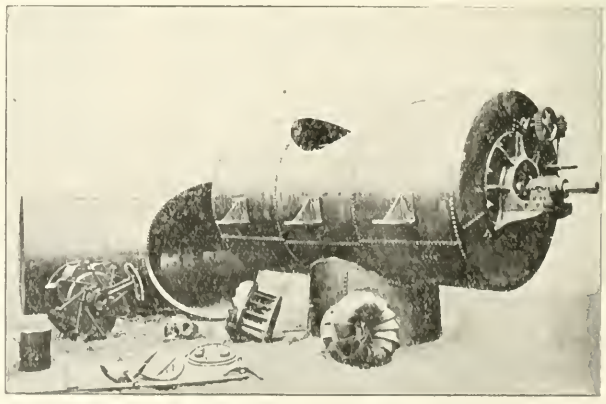
SIMPLE, SAFE AND RELIABLE

No Valves or complicated Mechanism to mystify and confuse. No Copper, Brass, or other dangerous element used in its entire construction. Write us your requirements and obtain prices.

KERR ACETYLENE GAS GENERATOR CO.
Box 24, NIAGARA FALLS, Ont.



SEND FOR CATALOGUE



AND FULL INFORMATION

CROCKER PATENT TURBINES

The Jenckes Machine Co., 20a Lansdowne Street, SHERBROOKE, QUE

The Canadian Engineer

VOL. VII.—No. 6. TORONTO AND MONTREAL, OCTOBER, 1899. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR, R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE.

Toronto Telephone, 1392. Montreal Telephone, 2589.

UNITED STATES AGENT:
H. E. BURNETTE, Cor. Fourth and Locust Sts., Philadelphia.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Accidents of the month	164
Architects' Association, Quebec	165
Concrete, The compressive strength as determined by tests made at McGill University	156
Canadian Electric Light Company's Works on the Chaudiere River, Quebec, The	159
Canadian Engineer, Good Work appreciated	165
Electric Flashes	175
Great Lakes Copper Co., The	165
Hudson Bay	156
Ice Breaking	163
Imports from Great Britain, Metal	165
Industrial Notes	173
Literary Notes	165
Mineral Industries of Ontario	160
Marine News	177
Mining Matters	177
Nickel Extraction by the Mond Process	166
Practical Man, The	163
Petrolia, Green Grass Grows All Around	156
Power	158
Personal	178
Parsons' Steam Turbine, Direct Connected	169
Railway Matters	179
Sand Filtration of Public Water Supplies	171
Separators, The Austin Steam	159
South Africa, Its People and Trade	154
Stoker Case, The	180
Toronto Exhibition Notes	164
Ventilating and Heating One-Story Buildings	158
Water, Article IV.	151

For THE CANADIAN ENGINEER.

WATER, ARTICLE IV.

BY W. M. WATSON.

The readers of the Canadian Engineer would understand the subject discussed in the present paper better if they will refer to the articles published in the issues of June, 1897, and of May and June, 1899. In the articles named, I tried to explain how necessary it is to be careful to lay down water mains straight, parallel, and carefully graded, having cutoff and washout valves properly placed, so that every section can be well controlled and thoroughly emptied and washed out, when required. Also, that the arrangement of street mains should be such, that when all are in full working order, the water the street mains contain is always on the move, and that in no part of the system can the water be motionless for days together.

During the fifteen years I have been in Canada, I have observed that waterworks are usually laid on what European engineers call the temporary system, that is in a zig-zag or snake fashion, laying them over hills and dipping the pipes down under valleys and gullies or culverts, paying no regard whatever to the depressions made in the pipes, that will form receptacles for dirt and poisonous matter, or to the air pockets that will hinder the flow of water and cause water hammer and damaging commotions to exist in the pipes, which start leakages and cause over 100 gallons of water to be pumped per head of population per day in Canadian waterworks, when the quantity actually used does not amount to over 40 gallons per head per day. In fact, as far as I can make out, the health of the public, who have to drink, wash, and cook, with the water carried to them by the street mains, receives very scant consideration, and the fearful cost of repairs and management, after the construction is completed, appears not to weigh one feather weight, I am told on all hands that the country is rich, and can stand it, though I know by experience that my taxes alone are nearly as much as both my taxes and rent were together when living in Great Britain I also know that the state and local bodies have mortgaged the property so well that our very clothing fits as if they are in the grip of the money-lender, yet money is wasted on public works just as if it were as plentiful as sand. The purest water can be fouled and badly contaminated during its passage through the water mains to the consumer, by allowing it to have a sluggish flow, and stand motionless for long periods in the pipes; also by allowing the minute particles of vegetable or other foreign and objectionable matter to remain in the pipes, and cause to incubate and multiply, at the rate of, often, millions an hour, poisonous microbes, which afterwards find their way to the taps and get mixed with the people's food. Experience has proved that all such objectionable matter lies in deep depressions, or is forced to the dead ends, and such street mains as are extended the furthest from the intake end of the supply. On that account it is absolutely necessary that washout valves be provided at such points of the water mains, so that the pipes can be thoroughly cleaned about once a month, without wasting much water. Some two years since, I saw in the newspaper that the Toronto analyst had been analyzing the city water, drawn from taps near the centre, and he reported the result to be good. On the same day, I was engaged unstopping a blocked water service in one of the side streets, about two miles west of where the analyst got the water he analyzed. On cutting and dividing the pipe, I found a frog's leg, a few small bones of a fish and some vegetable debris. Afterwards I allowed the water to run to clear it, and the quality that the pipe delivered was far from being fit for use for domestic purposes, and the analyst would certainly have said the same had it come under his notice. All the houses in that street are subject to periodical stoppages, on account of the water main in the street being dirty, and no proper means to clean it out being provided. The water at the intake pipe of the city of Toronto is excellent, but the distributing mains appear to have been laid without any thought of cleaning them out.

There has been said sufficient to show how the health of the people largely depends on the laying of the public water mains and service pipes, and may pass on to the costly damages and inconvenience of frozen

water mains and service pipes which are the outcome of poor construction. I have heard people say that freezing of pipes cannot be avoided, but I do not believe such statements, and if reasonable care is observed, there need be no difficulty of that kind. Since 70 per cent. of the water pipes laid never freeze, then why cannot the balance of 30 per cent. be made to resist severe weather. In several newspapers we have read during the last very severe winter that a fire occurred in a town and the firemen were badly hampered because the fire hydrant was frozen. After large sums of money have been spent to ensure security, the article is useless at the very moment its services are necessary. The citizens are living in false security, and their property may be all consumed and even their lives may be sacrificed because it takes time, a long time, to thaw out the fire hydrant before it can be used to quench the fire, and in that case the coroner would say that it was accidental death and no enquiry necessary, when the fact of the case would really be that the person had come by his or her death on account of the carelessness or want of knowledge of the person who set the hydrant. If the party who was responsible for properly fixing the hydrant were committed for manslaughter, there would be very few frozen fire hydrants. Every winter a large number of families suffer, because the private pipe supplying their dwelling is frozen solid, and to relieve them and thaw out their pipes small boilers on wheels are supplied, probably by the ratepayers, and a staff of men takes them from house to house, and thaws the pipes out by dividing the pipe at some convenient point, and working a small copper tube into the interior of the affected pipe, and blowing in steam, until the blockage is removed; but if the pipe fitter has laid the pipe in a snake fashion, and the small tube cannot be forced round the bends, then the services of the steam boilers are useless. We should insist that work be done by persons who thoroughly understand their business, and make them responsible for the work they do, or have a fully-qualified official to inspect the work and pass it, and thus avoid the necessity of thawing appliances, and the heavy expense of repairing damages done by frost to pipes containing water.

Perhaps a few suggestions and some practical examples of how to ensure pipes from freezing and the causes of freezing may be interesting. Water attracts frost, as well as other things, and the slightest dampness will carry a current of frost down to a metal pipe. By placing an open vessel of water in a room it will attract and absorb the frost, and in this way frost can be kept out of cellars.

By keeping this in mind when laying pipes and fixing hydrants, we may prevent the risk of freezing if reasonable judgment and care be afterwards observed in the management. I believe brass and copper will convey and carry frost along quicker than other metals; this is proved, because it is found that in most of the street mains that freeze and crack, the freezing first began at the brass bend, screwed into the crown of the main pipe, and attached to the private service pipe, and when water once begins to crystallize, it increases the crystallization right and left in the main pipe quickly, drawing the frost by way of the brass bend, similar to the tree getting its nourishment through the small rootlets; on this account we should endeavor when fixing water pipes containing water to disconnect the pipe from frost currents in a similar way, that electricians prevent electricity from being wasted or coming in contact with foreign bodies. This may be done in various ways, first by encircling the metal pipe with stagnant air completely void of circulation, because air is an excellent non-conductor; second, by burying in pitch, rosin, brimstone or wax, or covering the pipe with an air-tight stocking of rubber, gutta percha or dry paper with a waterproof coat of varnish on the outside, to prevent it becoming damp. If a pipe is properly insulated it will not freeze. Another important point is not to fix a pipe in a position where a strong current of air, however small the current may be, can strike it direct, especially at a bend or coupling; for instance, a house pipe is often brought up through the kitchen floor from the cold basement; if the hole in the floor is a little larger than the pipe, the chilled air will rush through the aperture round the pipe, and freeze it. Pipes will stand a considerable amount of cold without crystallizing the contents, if the air that surrounds them is nearly motionless. They always freeze first where the currents of air are the most rapid, however small a stream the current may be; so if it is possible to lay a main or a service pipe so that it cannot be approached by dampness, or where a circulation of air cannot come in contact with it, then it must be safe from frost. Some engineers will not allow the filling over a water-pipe to be pounded down solid, except the traffic of the road demands solidity, because the air between the particles of earth placed loosely over the water main forms a non-conductor, and cuts off the current of frost from descending to the pipe. Even in well pounded earth, that covers the water mains, there is some air, and no doubt it prevents the frost from descending to the pipes a little, and together with the heat that is absorbed from the earth that is attacked with frost by the lower stratum immediately under the frosted surface, is no doubt the cause why the dampness in the soil cannot convey the current of frost down to the main water-pipes if laid at a suitable depth.

It is unwise to allow a metal pipe containing water to touch other metal or damp stone or brick, if such metal, stone or brick communicates in any way with the cold atmosphere outside, because such metal will convey the frost similarly to a wire that conveys electricity. I think that the custom of fixing a bent brass union on the crown of a water main, to deliver a private supply, might be done away with, with advantage, and in the place of tapping the pipe at the crown, the pipe main might be tapped on one side, and in place of using copper bends and connections, annealed or malleable iron fittings should be used, because they cannot attract the cold so quickly as brass, and it is often the case that the water in the mains is constantly on the move forward, therefore cannot readily be attacked by frost; while the water in the brass bend and service pipe only moves when water is drawn into the house, and the contents of the pipe being afterwards motionless, is easily crystallized, and then starts the water in the main crystallizing, and in that way great mischief is done. This method would lower the house service connection as much below the crown of the water main, as the brass bend extends above the water main, under the present rule,

which would be right, because the house service needs more protection than the water main. The objection that the services would break away from the main, on account of expansion and contraction, when iron or brass pipes are used for service pipes, can be overcome by using two English slow bends, keeping them sufficiently apart to allow enough movement to take place that will overcome any expansion or sudden jars that might occur. I also consider the custom of putting a separate service pipe to each house, however small that house may be, or however many small houses are grouped together, is unwise. Water rapidly deteriorates when lying idle in pipes; not only do the friendly microbes in the water die off for want of air, but the water sets up a chemical action with the metal of the pipe. The public health demands that water pipes should, wherever possible, be worked to their fullest capacity, on that account the shortest length possible of service pipes should be used between the street main and the house taps, and as many as can conveniently be served from one pipe should be. Water mains are laid down considerably larger than is needed for domestic or trade supply, as a rule. First, because they may be called upon to furnish several streams at any moment to extinguish a fire; second, because a small cast-iron pipe, placed under a road, is easily broken by heavy traffic passing over it. So we see that it is necessary to prevent the water deteriorating or freezing in winter, to so arrange them that the water at all points is kept, if possible, constantly on the move or circulating, besides having plenty of proper provision for emptying and cleaning them out. There is a service pipe made that will resist frost; also preserve the purity of the water it contains, so far as to prevent the water from setting up any chemical action with the metal. It is made of common wrought iron pipe, having a thick, hollow core, or lining, of pure tin, forced into the interior of the iron pipe, and when forcing the tin into the inside of the iron pipe, a thin rubber cloth or other non-conducting material is placed between the two metals, which insulates the pipe, and prevents the frost having any action on the water it contains. Thus, by using that kind of pipe, the purity of the water is maintained, and the chance of freezing is nil, because it is impermeable to frost, on account of the insulator placed between the two metals, and being lined with pure tin, it is impossible for the water to set up any injurious chemical action.

To make the causes of freezing very plain, I will here relate a few of my own personal experiences. Last winter I was obliged to carry a small water pipe over a roof, and I knew the water would only move about twice each day, and there was a great difficulty presented against the pipe being boxed, so I simply insulated it by placing three-ply rubber hose over it, carefully sealed it at both ends to prevent any circulation of air between the iron and the rubber stocking, and the pipe did not freeze last winter, though the weather was severe and the pipe elevated high in the air. Frost will run down a pipe however well insulated, if the end is exposed to the air, because the frost will travel down the metal forward along the inside of the insulated covering. A customer of mine being troubled with mice, that ran along the pipe line of the water pipe placed under the floor boarding, crossing the joints, from the kitchen boiler to his bathroom, took up a board and encircled the lead pipe with a small piece of tin to stop the mice from passing over the joists alongside of the pipes. The house every year was kept so well heated that the pipe had never been known to freeze, but the small piece of tin made it freeze, at the point where the tin touched the lead pipe, because the tin attracted the little frost that was in the air between the floor and the ceiling, and drew it or focused it on to that part of the pipe that the tin touched, and just there I found the stoppage. Some twelve years since, the Grand Trunk Ry. offices, Montreal, were thrown in the dark by a stoppage of their gas supply. I found the defect was caused by the gas being frozen in the ¾" supply main place in the false roof, where the atmosphere never was less than 50 degrees of heat, therefore nowhere near the freezing-point, but a nail had fallen out of a shingle in the roof, and the heat of the false roof being near the seventies, and the outside being about 30 degrees below zero, there was a rapid ingress of cutting cold air through the small nail hole in the roof, into the false roof, which made a bee line to one of the ventilators placed in the ceiling to ventilate the office below, and on its passage forward it struck the gas pipe about the one-eighth of an inch in width, and crystalized the damp gas at that point, cutting off the supply.

There are many waterworks' fittings that have been carelessly constructed, and to rectify the injury done would cost a great deal, therefore if anyone can come forward and show how such badly-laid pipes can be prevented from freezing and bursting, or show us an easy way of thawing them out when they are frozen, they will be public benefactors and deserve commendation. Town councils and private individuals have had to part freely with their money, and suffer much inconvenience on account of shoddy work that could not be prevented freezing in past years. Electricity, which has a close similarity in its actions and methods of travel with frost, is proved by Professors Wood and Jackson to be able to thaw frozen pipes, small or large,

Hundreds of frozen pipes were thawed out last year by the electrical method, both quickly and at a far less cost than when the dirty steam kettle is used, and I cannot do better than repeat the report Mr. Hiem publishes of Messrs. Wood and Jackson's successful work in the thawing out by live electric currents. The attention of Mr. Wood was drawn to a service pipe that could not be thawed out by a steam boiler, nor could the kink in the pipe that was frozen be reached any other way until warmer weather should set in, so Professor Wood consulted with Professor Jackson, and both together they tried to thaw out the obstinate pipe by electricity, and succeeded beyond their expectation, and then they introduced the system generally. Mr. Hiem goes on to say:

"I will now give you the computations Professor Jackson was kind enough to give me, and which have been verified in the different cities where the conditions were proper and the thawing successful. To thaw out lead or iron services up to one and one-half inch you should use from 200 to 250 amperes; if you are not able to get more than 125 amperes, it will take four times as long. If you use over 250 amperes you are liable to get into trouble by overheating the corporation stop-cock, and all other brass connections. Wrought-

iron pipe must be watched very closely so that the joints do not heat; it has lower resistance, higher conductivity, requiring more current, in order to make more heat, therefore you must watch the unions—that is where the heat occurs. It is necessary to use a source of current which does not affect the electric light lines or other transmission lines; if current is taken from them, danger may result. We have therefore ordinarily used a transformer in the work, but in some cases have used dynamos directly. The source of current should have a pressure of not less than 50 volts. To thaw out 500 feet of a six-inch main in half an hour requires 800 amperes; if you are unable to get more than 400 amperes it will take four times as long, or two hours. Eight hundred amperes will thaw out 500 feet of a 12-inch main in one hour, and a 24-inch main in two hours, etc. The source of current for water mains should have a pressure of not less than 200 volts.

"In preparing to thaw out a water main, connect with two hydrants, winding the wire around the hose nozzle. Screw hydrant nozzle cap up to the wire, making a close connection, commence at open end, where there is no frost, with 800 amperes or less and 200 volts, and thaw say 500 feet at a time. Water should be kept running for at least an hour after the main has been thawed, as it will take that length of time before the water will be slightly warmer. Three-quarter h.p. will thaw a six-inch main in half an hour per foot length; two-tenths h.p. will thaw a one-inch, and one-eighth h.p. will thaw a five-eighths service pipe in half an hour per foot length. There is no danger from electrolysis, on account of the short duration of the thawing process and the ground being frozen. Herewith are the directions for thawing service pipes up to one and a half inches in diameter, which were prepared and sent out by the University of Wisconsin:

" 'The current, which is required for thawing service pipes satisfactorily, is from 200 to 300 amperes. The source of current should have a pressure of not less than 50 volts. Where electric light lines carrying alternating currents are available, a transformer or transformers in parallel may be used as a source of current. It is very important that direct connection of pipes to house lines be avoided on account of danger of fire in which the house is placed by such connection. Where alternating currents are not available, continuous current feeder lines may be used, but these should be entirely separated from the distributing net work of conductors. The way in which the appliances should be connected when an alternating current is used with transformers is as follows: The secondary leads from the transformer should be quite large, such as No. 3 B. & S. gauge, or larger. In making connection to the pipes, one of the secondary leads should be taken into the house, to which the frozen service pipe leads, and contact made at that point by some form of metallic clamp or by simply giving the conductor two or three tight twists about the pipe at any point where the pipe is exposed or at a faucet in the house. The other secondary lead should be put in contact with the water system outside of the house and in a similar manner. This contact may be made at a hydrant or at an adjoining service box, or pipes in a neighboring house. When there are two houses near together, each with frozen service pipes, the two secondary leads may be connected to the pipes within these houses and both frozen service pipes thawed out at once. While the thawing process is going on, the faucet should be open in the house to which the service pipe leads. In one of the secondary leads should be inserted a water resistance, which consists, for convenience, of a bucket of water containing a bowlful of salt, and two sheet-iron or copper plates to which the ends of the severed lead are attached. This serves to control the current. In the primary leads from the electric light line to the transformer it is highly desirable to have a fuse in each lead, and an amperemeter. When all connections are made, the plates are placed in the bucket and are then moved towards each other until the amperemeter records a proper current. If the primary pressure is 1,000 volts and the secondary pressure 50 volts, the current should ordinarily approach 15 amperes. If the primary pressure is 2,000 volts, and the secondary pressure is 50 volts, the amperemeter reading should ordinarily approach 7.5 amperes. Water ordinarily begins to flow in a time not much less than ten minutes, or not greater than one hour. If the secondary current is quite close to 300 amperes the period seldom exceeds one-half hour. The frozen pipes are often split by the action of the frozen water, and these at once begin to leak when the ice is thawed away. For this reason it is desirable to have a plumber where he may be readily called to care for the leaky pipe. The electric current when properly used will not damage the pipes. It is desirable to watch brass and iron connections to lead or iron service pipes, as they sometimes heat on account of poor contact. If such heating appears to be excessive, the current may be reduced with a resulting increase in the duration of time for thawing. After the pipe has been thawed it is desirable to let the water run continuously for a considerable time, inasmuch as the ground all round the pipe is frozen, and the pipe is liable to freeze up again unless the water circulates.' In closing this paper let me give you an extract from an insurance paper, as to the financial result of this discovery: 'A slight estimate of the value of the invention of thawing out frozen pipes by electricity to underwriters can be found from the fact that in 1898, insurance companies paid out nearly $300,000 in losses caused by primitive methods of thawing out pipes.' "

SOUTH AFRICA, ITS PEOPLE AND TRADE.

ARTICLE I.

The obduracy of the Transvaal Boers and their president in refusing to concede the common rights of man to citizens not of their own race, is turning the attention of the civilized world to South Africa and its people. That quarter of the world possesses unusual interest to Canadians, not only from the standpoint of imperial politics, but from its commercial development and its possibilities as a field for Canadian trade. As a prelude to a review of the prospects for Canadian manufacturers and exporters, it will be well for the reader to know something of the causes of the present political complications.

The Cape of Good Hope, though discovered by Diaz, a Portuguese navigator, six years before Columbus landed in America, and though used as a port of call by the Portuguese for a century afterwards, it remained for two English captains, in the employ of the

East India Company—Shillinge and Fitzherbert—to make formal claim of sovereignty in the name of England in 1620. After some rivalry between the English and the Dutch East India companies, the latter, realizing the salubrity of the climate and the fine soil, sent out an expedition under Jan Van Riebeeck—in whose honor the Hon. Cecil Rhodes has recently had a statue erected in Capetown—to make a permanent settlement, and thus began in 1652 the Dutch occupation of the Cape. Little by little the settlements extended back from the Castle on Table Bay, but the life of the settlers was the life of white slaves. They were not allowd to sell their produce to visiting ships, but could only sell to the company at prices fixed by the company. On the other hand, they were not permitted to purchase goods except from the company and at prices fixed, of course, by the company. They and the artisans of the town were, moreover, bled at every turn by the company's officials, and if they attempted to complain to headquarters in Holland their complaints were either suppressed altogether, or the complainants were imprisoned as treasonable persons or otherwise marked out for persecution. The farmers had no title to the lands they brought under cultivation, and were often ejected after working a lifetime upon their lands. They were plainly told that they held their property by grace of the company. Offences, which now would scarcely come under the criminal code, were visited with death in its most fiendish forms. Crucifixion was a common mode of capital punishment, and another was the tying of the victim with his back on a wheel, where his body was broken, and he was left "a prey to the birds of heaven." The rack and the gallows were the common means of punishing slaves. It is not to be wondered at that the Dutch settlers sought to escape this tyranny, and from time to time, in spite of threats and the company's claim of jurisdiction, many got beyond the reach of the company, risking the enmity of the natives in their migration. Thus began the "trekking" of the Boers, which dates back to 1670, and has been a peculiar characteristic of Dutch colonization down to the present day.

During the upheavals of the French revolution, England felt the necessity of possessing the Cape to save her East Indian trade, and after a feeble resistance the Castle capitulated to Sir James Craig in 1795. At the peace of Amiens in 1803 the Cape was restored to the Dutch, but was finally taken in 1806 by Sir David Baird. The first taste of individual liberty and reasonable government enjoyed by the Cape Dutch was given to them by Great Britain. With the advent of Britain at the Cape, the Dutch farmers got their first clear titles to land, they get district courts, where justice was for the first time administered with fairness and without the corruption which had made their masters so odious. The people got their first regular school system, and their first postal system from their new British rulers, who also did away with the system of punishing offenders by the cross, the wheel, and the rack, those brutal instruments of torture being destroyed at the very outset of the British regime.

Such, in a few words, was the contrast between British and Dutch rule at the Cape. It is not to be denied that between the Home Government and the colonial rulers many mistakes have been made in the subsequent history of British rule in South Africa; but more often than otherwise these errors were made through mistaken leniency or mistaken philanthropy towards Boer and native alternately. Perhaps the most unpardonable grievance nursed by the Boers in the present century was the emancipation of the slaves in the Cape Colony in 1837. Many Boers to the present day believe with apparent honesty that a Kaffir has no soul, and class him with the wild beasts of the veldt. While other nations besides the United States have freed the slaves without compensation to the slave owners, Great Britain voted to the slave holders of the Cape £1,247,000. This was only half the amount of the appraisement, but it must be remembered that the slaves of the West Indies and other parts of the empire had to be freed at the same time at a total cost of £20,000,000—an enormous sum for those days—and the sublimest exhibition of the awakening of national conscience ever recorded in the history of nations. Though the Boers must have known from the agitation that had been going on in England for the preceding thirty years that the emancipation of slaves must come, there was a great outcry when the amount of compensation was announced, and, to make matters worse, from their standpoint, a horde of self-appointed agents, working on the circumstance that the money had to be paid in London, bought up the claims of the farmers for a mere song in many cases, and the enraged slave-owning farmers trekked into the interior to the number of several thousand, founding what is now the Orange Free State, the Transvaal, and a portion of Natal. British settlers had anticipated them in Natal, and after some bloodshed and a few years' hesitancy on the part of the Home Government, British sovereignty was proclaimed over Natal in 1843. Although the British Government had warned the emigrant Boers that they were still British subjects, those who settled in the Free State and the Transvaal were allowed to rule themselves. The Free State was indeed taken under British rule for a number of years, but that rule was withdrawn under the protest of a large minority of the inhabitants, and the State was left an independent Republic in 1854. Under the wise and common-sense rule of the late Sir John Brand, who was president for twenty-five years, the Free State has had till now the best relations, almost uninterruptedly, with Great Britain and with her colonial neighbors. There was but one serious difficulty and that arose out of the discovery of the diamond fields on the borders of the State in 1867. The land had been owned and was still claimed by a Griqua chief, named Waterboer, and the British Government having bought up his rights, proclaimed the diamond fields British territory in 1871. The Free State, which had claimed a part of these fields, withdrew under protest, but whatever the merits of its claims they were generously compensated by a payment of £90,000, with which the little State was well satisfied, and with which it built its first railway—a road that stands to-day as the best asset possessed by the State. While the Dutch in the Free State and Natal, as well as in the Cape, have settled down to a fairly general friendliness towards the British, the history of the Transvaal Boers has been marred by a strong and persistent hatred of British Government and people. Peopled largely by the irreconcileables, who had left Natal and the Free State on the advent of the

British, and utterly unable or unwilling to understand the British idea of government of the Kaffir tribes, they have become the Ishmaels of South African civilization —their hand forever against the Kaffirs on the one side and against the British on the other. They have so far failed to see the advantages of the golden rule, or to read the signs of the times, that they have perpetuated the same ideas of lordship as those under which their ancestors groaned in the 17th century. In 1877, when the country was in a state of bankruptcy, Sir Theophilus Shepstone annexed the Transvaal to the British Empire, without active opposition. Whatever may be thought of this step, it was taken with the best intentions, and with the desire to save the Boers from the destruction which would have been their fate at the hands of the Zulu King Cetywayo. The step once taken, it is now generally realized that a terrible mistake was made in giving the country back to what has proved a monstrous system of misrule. The British Government, however, gave the Boers just ground of complaint when it left the Transvaal for three years without any representative institutions, and permitted during that time a military aligarchy, composed of men who gave no consideration to the susceptibilities of the Dutch inhabitants, a large part of whom would have been fairly contented under a system which gave them a voice in the affairs of the country. It was unfortunate that just when the British Government began to be awake to the seriousness of Boer discontent, and were actually considering the constitution framed by Sir Bartle Frere, the flames of rebellion broke out, with the result that the British were defeated in three engagements, through the guerilla tactics of the Boer sharpshooters, and then the Gladstone Government restored the republic under that "suzerainty," which has been ever since a source of misapprehension to the Boers.

Before alluding, in our next article, to the present condition of affairs in South Africa, it is worth while to remember this teaching of the past, that wherever the British and Dutch have co-operated either in colonization, in politics or commerce, they have both prospered. The British possession of the diamond fields was the financial salvation of the Free State; and the British operation of the Transvaal gold fields has lifted that republic from commercial nothingness to a state that has become at once the chief power and the chief danger to the neighboring states and colonies.

HUDSONS BAY.

A. P. Low, of the Geological Survey of Canada, has returned to Ottawa, after fifteen months' exploration of Hudson's Bay. Mr. Low left Ottawa in the spring of 1898 for the Atlantic coast, from whence he went by steamer to the eastern mouth of Hudson's Straits, where he took a yacht and explored the coast down to Great Whale river, a part of the bay not previously explored. Several large rivers were discovered, and great quantities of fish were found, especially in the mouths of the rivers. The fish found were Arctic salmon, whitefish, trout and cod. Mr. Low thinks that they are in sufficient quantities to make fishing for commercial purposes very profitable. The winter of 1898—99 was spent in Great Whale river, Mr. Low and his party living in snow houses. There was not much work done during the winter, as there was barely six hours' sunlight a day; but during the past summer a very large tract of country inland was explored, and some valuable mineral discoveries made, of which details will be given in his report to the Government, which will be made at an early date.

GREEN GRASS GROWS ALL AROUND PETROLIA.

A wail has gone up from Petrolia, Ont., because the Imperial Oil Co. has removed everything pertaining to the oil industry from Petrolia to Sarnia, Ont. As the mouthpiece of the local sorrow says, the "oil wells are there yet." But that need not comfort the town too much, because these wells can only be pumped when the Imperial Oil Co. requires oil, and when the well-owners are prepared to take the price the company feels prepared to pay. When everything has been got on a business basis, the company will pay only what is good for it, and those who know the Standard Oil Co., know what that is. When the people of Petrolia, Ont., refused to bonus the Bushnell Oil Co., some few years ago, they were unaware that the Standard Oil Company then promised that grass would grow in the streets. They did not know, perhaps, that the Bushnell Oil Co. was then, as the Imperial Oil Co. is now, one of many nice little properties which are owned by the Standard Oil Co. In the meantime the grass is beginning to sprout, and the Standard Oil Company monopolizes the oil business of Canada.

—Occasions have been numerous in Canada where one town has had to call upon another for assistance in fire-fighting, and frequently engines, etc., are sent from one town to another. It has been found that in some such cases the borrowed apparatus was entirely useless because the hose couplings were not of uniform size, and therefore they could not be used in conjunction with the apparatus already on the ground. This should be remedied.

THE COMPRESSIVE STRENGTH OF CONCRETE AS DETERMINED BY TESTS MADE AT McGILL UNIVERSITY.*

BY W. B. ANDERSON, STUDENT CAN. SOC. C.E.

Concrete, especially in the construction of piers and foundations, is coming every year into more extensive use. It is therefore desirable to determine its strength, and more particularly the resistance to crushing, as it is to a compressive force that it is most often subjected. The results of very few tests with this end in view are given in any of the treatises on concrete or building materials, or in the engineering journals. A few results may be found, but they are scattered and very irregular, and little information can be obtained from them. During the past three years a few tests have been carried on by the students of civil engineering at McGill University. The first series, two years ago, was to determine the effect of different percentages of water upon the strength, and the best percentage to use. This was found to be about 20 per cent. of the sand and cement. Last year tests were made comparing the strengths of concretes made respectively from an English Portland and a German one. This year tests were made upon sand cement in order to compare it with the Portlands, and also to determine the best proportions in which to mix it in making concretes. This cement was "Cathedral" brand sand cement, made by the "St. Lawrence Portland Cement Co." of Montreal. It is made of equal parts of Portland cement and kiln dried pump sand. These are run together into a revolving cylinder half full of flint pebbles, where they are thoroughly mixed and ground to an impalpable powder.

*From a paper read before the Canadian Society of Civil Engineers.

The conditions under which the tests were made this year were the same as those of the first series (published in paper No. 117, Trans. Can. Soc. C.E.), except that the blocks were made 9 x 9 x 12-in. instead of 12-in. cubes, as the cubes were found, in some cases, to be too strong for the testing machine to break. The blocks were tested with their long edges vertical, and rested on a steel plate which was on a ball and socket joint, the plate above the block being fixed. Sheets of rubber were inserted above and below the block to give a more uniform distribution of the load. The blocks were allowed to stand in the moulds for about two days, and were then removed and placed in water, where they were kept until the time of testing. The results of all the tests made in 1898, and the more striking ones of other years, are here presented in tabular form:

RESULTS OF EXPERIMENTS ON THE COMPRESSIVE STRENGTH OF CONCRETE.

		Mixture.					Breaking Loads lbs. per sq in.				Relative Costs.	
No. of Tests.	Date of Test.	Cement.	Sand.	Broken Stone.	Percentage of Water.	Weight in lbs. per cu. ft	One week	Four weeks.	Two months.	Proportion of mortar to broken stone.	Relative amounts of cement.	First Assumption.	Second Assumption.
*1	1896	1	2	4	20	139.5	746	626	507	60-80	157	174	126
*2	1896	1	2	5	20	.....	...	703	...	-100	137	152	121
*3	1896	1	2	6	20	.....	...	728	...	-120	122	135	116
*4	1897	1	1	1	22½	142.3	x	x	...	60-30	367	407	206
*5	1897	1	1	2	22½	146.7	1037	x	...	-60	275	305	175
*6	1897	1	1	3	22½	148.0	x	x	...	-90	220	244	156
*7	1897	1	1	4	22½	153.3	x	x	...	-120	183	204	144
*8	1897	1	1	5	22½	151.2	x	x	...	-150	157	174	135
** 9	1897	1	2	2	20	143.5	494	505	...	60-40	220	259	150
**10	1897	1	2	3	20	146.0	611	555	...	-60	183	216	139
**11	1897	1	2	4	20	148.5	819	613	...	-80	157	185	131
**12	1897	1	2	5	20	150.5	581	680	...	-100	137	162	124
**13	1897	1	2	6	20	150.0	500	608	...	-120	122	143	120
**14	1897	1	3	3	20	139.5	333	205	...	60-45	157	185	122
**15	1897	1	3	4	20	139.0	...	366	...	-60	137	162	117
**16	1897	1	3	5	20	145.0	...	386	...	-75	122	143	113
**17	1897	1	3	6	20	147.0	...	357	...	-90	110	129	110
†18	1898	1	3	5	20	146.5	144	274	400	-75	122	122	104
†19	1898	1	3	6	20	146.4	110	182	218	-90	110	110	102
†20	1898	1	3	7	20	150.3	210	322	...	-105	100	100	100
†21	1898	1	2	4	20	150.6	316	441	...	60-80	157	157	110
†22	1898	1	2	5	22	148.5	275	477	494	-100	137	137	114
†23	1898	1	2	6	20	154.0	521	630	670	-120	122	122	111
†24	1898	1	1½	3	20	149.8	412	400	...	60-72	200	200	134
†25	1898	1	1½	4	20	151.5	446	670	...	-96	169	169	126
†26	1898	1	1½	4½	20	153.5	536	741	...	-108	157	157	123
—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	2	4	5	6	7	8	9	10	11	12	13	14	15

Brand of Cement—*German Portland "Hemmoor" Brand. **English Portland "Anchor" Brand. †Sand Cement "Cathedral" Brand. Blocks marked thus (x) remained unbroken under a load of 1,050 lbs. per square inch.

Column 13 shows the relative quantities of cement in the different mixtures, and some attempt has been made to estimate the cost of the different mixtures on this basis. The relative costs are compared on the following two different assumptions:

First assumption—Column 14 shows the relative costs if it is assumed that the sand and stone can be secured on the spot and their cost ignored. The cost of different brands of cement is taken as below.

Second assumption—Column 15 shows the relative costs of the different mixtures and brands on the following assumed costs per cubic foot of materials

English Portland	53 cents.
German Portland	50 cents.
Sand cement	45 cents.
Broken stone	8 cents.
Sand	2 cents.

The cost of labor is not taken into account, as it will be the same in every case, and these costs can at best be only a rough approximation.

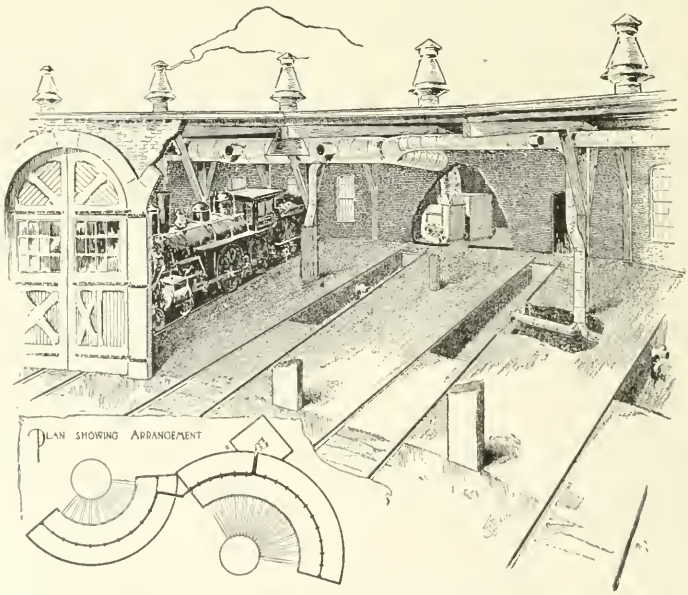
The main requisite for an economic and good concrete is to have just enough cement to completely surround every grain of sand, and just enough of this mortar to fill every interstice between stones. Column 12 gives the proportion of mortar to stone, and it will be seen that with each different mortar the strength increases as the proportion of stone increases, or as the volume of interstices between the stones decreases, because the mortar is not so strong as the stone. The strength also increases with the richness of the mortar in cement, so that the strongest concrete will be one with very little sand and a great deal of stone. Those with the 1-1 mixtures of mortar are very much stronger, though also more expensive than the others. The sand cements are found to be weaker than similar mixtures of Portlands by from 12 per cent. to 40 per cent. The manufacturers claim that with a mortar, such as a 1-10, with a great deal of sand, this cement is stronger than the Portland. This remains to be determined. If the concrete is desired to have very great strength, a Portland cement and a rich mortar might be used, but if weight is the main consideration, with only moderate strength required, a concrete of sand cement will be much cheaper and quite efficient. Of course, much cheaper mixtures than the ones tested can be made, but they will be weaker accordingly after a certain limit is passed, which limit has not been reached in these experiments. One of the cheapest and a fairly strong concrete is No. 23. This mixture would seem the best to use if excessive strength were not required. The loads given in the table are the actual crushing loads. The blocks showed cracks or signs of failure before this load was reached, but it was thought better to make the comparison on this basis. For purposes of comparison it is best to take the results of the four-week tests, as the concretes then show more uniform results than at one week, and the two-month tests are not complete. These tests are still very incomplete, and it might be profitable to make further tests with concretes containing more stone. The strongest of the sand cement mixtures is No. 26, and with this rich mortar it looks as if it would stand a good deal more stone, thus increasing both the strength and weight, and reducing the cost. Tests of this nature will likely be carried out at McGill University in future years.

—S. T. Bastedo, Deputy Minister of Fisheries, and A. M. Wickens, the inspector of boilers, recently made a test of the tug "Gilphic," which the Ontario Government has purchased to be used as a patrol boat on Lake Huron and Georgian Bay waters.

VENTILATING AND HEATING ONE-STORY BUILDINGS.

So far as their construction is concerned, the simplest of all structures requiring ventilation and heating are one-story buildings, such as mills, shops and exhibition buildings. But no other form of building has so large an amount of wall and roof space per cubic foot of enclosed space, or such high and extended rooms; in fact, such a building, as a rule, forms only a single room. As a consequence the most efficient system is necessary; it is not alone sufficient that the apparatus shall be large, to allow for the excessive heat loss from the building, but, above all, the arrangement of the distributing ducts must be such as to most economically utilize the heat supplied; for underheating at the floor and overheating above is one of the most natural consequences of an imperfect system of distribution. Under such circumstances the apparatus itself is frequently condemned as having insufficient capacity, when the trouble lies entirely in the manner in which the heated air is delivered to the building. In buildings of this type the principal provision is to be made for the heating, for the occupants are generally separated, and the air supplied for heating will answer all the requirements of ventilation. But it is nevertheless necessary that they should be provided with fresh air in sufficient quantity. One of the inherent virtues of this method of heating is that it ensures such supply. As the air provided is generally in excess of that required for ventilation, increased economy can be secured by using over again a portion of the previously heated air. This may be done by arranging dampers or doors so that part of the air entering the heater is drawn from out of doors and part, or, if desirable, the whole from the room. In fact, in the ordinary manufactory the common practice is to nominally take the entire air supply from within the building. This does not result, as might be supposed, in a total lack of ventilation, for a very considerable amount of outward leakage takes place through the walls and around windows and doors. Sufficient, indeed, to cause a similar inward, but imperceptible, leakage at other points in such quantity as to result in a comparatively frequent change of air within the building. One of the greatest difficulties in a building of this character is to heat it rapidly in the morning, after it has cooled during the night. No other system can so completely and rapidly meet this requirement as that here presented. When it is desirable, the engine may be run slowly all night and the building maintained at a moderate temperature. The exhaust from the engine being used in the heater, no expense is entailed for motive power.

Chicago, St. Paul, Minneapolis & Omaha Railway Co., Roundhouse, East St. Paul, Minn., shows that the proper heating of a roundhouse presents a double problem, for not only must its temperature as a whole be kept uniform and sufficiently high, but provision must be made, where heavy snow storms are prevalent, for rapidly melting from the running gear of the locomotive the burden of snow and ice with which it is so frequently encumbered when first returned to the roundhouse from a long run. The general method of solving the problem is made evident in Fig. 58. An overhead system, with hot air discharged toward the walls, serves for the general warming, while special pipes, to be used when desired, conduct large volumes of air to the pits, where it is well distributed beneath the locomotives.



Chicago, St. Paul, Minneapolis & Omaha Railway Co. Roundhouse, East St. Paul, Minn.

POWER.*

BY P. TROWERN.

At our last meeting I drew attention to the power of the steam boiler, not the engine. The boiler is the place we gather the force, power or energy together, and from thence lead it into the engine, to turn our shafts, pulleys, belts, mills and pumps. I will again repeat what I told you about the steam. It is not the water that gives the power, but the fire gives the heat to the water, which becomes a medium and expands, so that one cubic inch will become one cubic foot, or one cubic inch will expand to 1,728 cubic inches (one rule says 1,680 cubic inches, another says 1,700 cubic inches, and another says one cubic foot or 1,728 cubic inches), at 15 lbs. pressure. It is very clear that the power is in the heat alone, which is embodied in the water we call steam and power in the boiler. I have laid before you some rules. They have been making boilers by them. Yet none seem to be up to the scientific mark nor satisfactory.

I would like some of your readers to take up the subjects I have mentioned in friendly talk. The Centennial Exposition standard is that the evaporation of 30 pounds of water per hour from feed water, having a temperature of 100° F., into steam having a pressure of 70 lbs. per square inch is equal to one horse-power. The American Society of Mechanical Engineers' standard is that the evaporation of 34½ lbs. of water per hour from and at 212° F. is equal to 1 horse-power. With a 60-inch tubular boiler, properly made, well set, and carefully fired, from 8 to 10 lbs. of water to 1 lb. of coal should be made into steam of 60 lbs. per square inch. This would depend on the quality of the coal and the temperature of the feed water. Practically no more coal will be required to convert 1 lb of water into

*From a paper read before the C. A. S. E., No. 18, Toronto.

steam at 80 lbs. than it will at 60 lbs. Theoretically it will require 4-10 of 1 per cent. more.

When setting boilers in brick work the practice is to rake in the side walls to the shell a few inches below the water-line, and thus limit the heating surface. It is customary in calculating the surface of the shell to consider that two-thirds of it is exposed to the action of the heat. In estimating the heating surface of a boiler, take 2-3 of the outer surface of the shell and the whole of the inner surface of the tubes or flues; reduce the whole to square feet, divide by 12 for two flue boiler, and by 15 for multi-tubular boilers, the quotient will be the horse-power; from 14 to 18 square feet per horse-power. Eight months ago I had a new boiler given to me with a shaking grate. It very soon ceased to move, and became expensive to be used, both in labor and coal. I have removed the grate and put in one, cost about one-half, pulled out the brick bridge, filled up a big pit behind called a combustion chamber, and enlarged the ash pit. The new bars are 5 feet long by 6 inches wide, herring bone draught; and instead of the bars dipping behind 3 inches I have raised them ¾ of an inch per foot, and the brick bed behind to the end of the boiler one foot short, with the same grade; or in other words, the front of the boiler is 20 inches above the bars, and the back end of the boiler is 10 inches above the brick bed, or wall. This end I call my bridge, because as the flame passes from the brick bed around the end of the boiler to enter the tubes it drops the ashes and soot into the pit, to be drawn out through the ash door behind. Building the brick work like this gives the inspector an opportunity of seeing the boiler from one end to the other, and also to crawl through to examine the bottom of the boiler from end to end. During my past forty years of building in boilers in this style, I have not had a blister, nor defect in the row of rivets, because the intense heat of the fire is spread from the front end to the back end, much alike, with a better draught. Since I have changed the bars and the bridge we have done the same amount of work with less labor and coal. I have 22 boilers like this one, built in, now in good working order. One of these was made with Low Moor iron by Mr. Currie for me, in the year 1862, and is in good working order now. Some time ago I conceived the idea of knowing the difference of the pressure of the steam on top of the water in the boiler and that below the water. I fitted a pipe to the blow-off pipe at the back end, and put a gauge on it at the same level as the gauge in front, which was pointing to 60 lbs., the one at the back pointed to 52 lbs. I tested both the gauges. I have said the boiler was 5 feet diameter, 14 feet long. I then thought if the exhaust steam could be brought back to the boiler without losing much heat or pressure it might be of great use in saving the use of steam in the future, for it appears other power is going to take its place.

I am now about to ask each one of you to assist me in solving a great question. In almost every country in the world men have been trying to make the most of the heat in the steam by pushing it into a condenser to heat the water, to feed the boiler with it as well as to avoid the pressure of the atmosphere against the exhaust steam when leaving the cylinder. For many years I have been engaged in heating a building with hot water and returning it again to the boiler. This is the question: How can we do it with steam in the boiler at 60 lbs. and cylinder at 50 lbs ? What arrangements with valves or any other plan could be adopted to save the heat by getting the steam back again into the boiler without condensation or losing its heat more than in passing from the cylinder to the boiler ? I will now turn your attention to liquid air. Liquid air is ordinary air as we breathe it compressed to 1-781 of its normal bulk, or in other words 1,781 feet are pressed into the space of one foot, and reduced to a temperature of 320° below freezing. It has an expansive force of 2,000 pounds to the square inch; it has a latent force of 100 times greater than steam, and as a motive power it is thought that it may be proved to be superior to any known force in or of nature.

—The Rideau Lakes Navigation Co. is a new organization of Ottawa, Kingston and Perth capitalists, who will in the course of a few days make application for letters patent. The capitalization will be $100,000. The company proposes to operate a line of steamers between Ottawa and Kingston by the Rideau River and lakes, and take steps to develop the country as a resort for tourists.

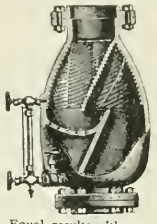
THE AUSTIN STEAM SEPARATORS.

The illustrations accurately detail the construction of the horizontal and vertical separators. By the use of the Austin separators, impurities of whatever nature are, its makers claim, removed from exhaust steam. The steam is immediately given a circular travel (the acknowledged principle for perfect separation) and all impurities or condensation which may escape the corrugations are extracted by centrifugal force aided by gravity, while passing over the separating plate. The steam is in continuous contact with separating surfaces during entire passage through this machine, the makers state. Grooves draining corrugations lead to separating plate, which convey to bottom chamber all impurities, which are discharged through outlet as shown. All practical users of steam power appreciate the importance of condensation being removed from live steam, as when saturated with water there is great danger of cutting the edge of valves and ports, which is not only injurious to the engine, but causing leakage and improper distribution of steam,

"HORIZONTAL"

Can be connected either right or left hand.

"VERTICAL"



Equal results with upward or downward flow of steam.

makes the expense of operation far greater than should be with steam perfectly dry; if there is much condensation in live steam it is apt to cause wreckage of engine by forcing out cylinder head and damaging the working parts. With wet steam proper lubrication of cylinder is not obtained, on account of the hot water neutralizing the action of oil in cylinder and permitting its cutting, practically having the same effect as if no oil was used. Wherever live steam is carried long distances a large element of condensation takes place, which will be entirely eliminated, the makers of the Austin separator believe, by use of their machines, averting all possibility of accident from water in cylinder, the engine working much smoother and greater power obtained. When exhausting into a tank or open heater or where exhaust steam is used for heating purposes and condensation is returned and used as feed water, the oil in exhaust will not only ruin boiler but cause foaming. By using one of these separators in exhaust steam pipe all grease, oil and other impurities will, it is said, be removed. The Austin Separator is manufactured by the Austin Separator Co., 59 Woodbridge street west, Detroit, U.S.

THE CANADIAN ELECTRIC LIGHT CO.'S WORKS ON THE CHAUDIERE RIVER, QUEBEC.

The contract for the works on the Chaudiere River, Quebec, to supply electric power and light to the town of Levis, was signed a short time ago by John Breakey, president of the Canadian Electric Light Company, and C. H. Deans, president of the New York Engineering Contract Company. The works, which are to be in some respects the largest in Canada, to be completed and delivered within six and a half months. The contract calls for the construction of a concrete dam, 900 feet in length, and bulkheads 100 feet long, bringing the total length of the dam to 1,000 feet. Besides the dam the company will build gates, bridges, earthen embankment, boom and piers, pipe supports, power house foundations and tail race, the whole to be completed and in running order by about the 10th of March, 1900. With this dam the company guarantees to supply a minimum of 5,000 h.p., and Levis and surrounding municipalities will be supplied with electric light and power. At the annual meeting of the Canadian Electric Light Company held on the 27th of June last, the directors in their report stated that they had secured exemption from taxation for twenty years in nearly all the municipalities in which the company will work. Besides this a large number of contracts for the lighting of public buildings and residences in Levis and neighborhood, has already

been signed, the Chaudiere Valley Railway Company is to be constructed and operated with the company's power, and the intention is to construct, as they are needed, other electric railways in the counties of Levis, Bellechasse, Dorchester and Lotbiniere. The plans were prepared by the well known engineering firm of T. Pringle & Son, Montreal. A. R. Henry, M.E., is the electrical engineer of the company.

MINERAL INDUSTRIES OF ONTARIO.*

Summary of mineral production in 1898, with quantity and value of mineral production in 1898, with number of workmen employed and amount of wages paid for labor:

Product.	Quantity.	Value	Employees.	Wages.
		$		$
Building stone, rubble, etc	.....	750.000	1,250	520,000
Cement, natural rock barrels	91,528	74,222	85	23,784
Cement, Portland, barrels	153,348	302,096	220	104,350
Lime, bushels	2,620,000	308,000	548	127,000
Drain tile, number.	22,668,000	225,000	2,622	456,000
Common brick No.	170,000,000	914,000		
Pressed brick and terra cotta, No.	8,969,868	100,344	126	42,580
Sewer pipe	.....	93,717	77	26,260
Pottery	.....	155,000	164	61,000
Petroleum, gal.	26,978,977	.....	....	.....
Illuminating oil, gal	12,281,622	1,243,490		
Lubricating oil, gal	2,043,226	202,150		
Benzine, naphtha, gal	1,240,967	121,840		
Gas and fuel oils and tar, gal.	8,047,441	286,705	546	263,455
Paraffin wax and candles, lb.	2,616,086	116,349		
Natural gas	.....	301,600	85	31,457
Carbide of calcium tons[1]	1,040	55,976	33	16,398
Salt, tons[1]	59,385	278,886	191	60,629
Gypsum, tons[1]	3,000	4,000	15	2,000
Graphite, tons[1]	300	6,000	10	1,800
Mica, tons[1]	34	7,500	15	4,500
Iron ore, tons[1]	27,409	48,875	100	26,700
Pig iron, tons[1]	48,253	530,789	130	61,476
Nickel, tons[1]	2,283¾	514,220	637	315,501
Copper, tons[1]	4,186¾	268,080		
Gold, ounces	16,261	275,078	580	290,919
Silver, ounces	86,600	51,960	59	28,430
Totals	.....	7,235,877	7,495	2,464,239

[1] Net tons of 2,000 lbs.

BUILDING MATERIALS AND CLAY PRODUCTS.

Statistics of building materials were not collected for the year 1897, and for that year they are incomplete. The years of depression had seriously affected the building trade, and production fell off steadily for some time. But with the revival there is a brisker demand for building materials, and it is noticeable also that there is a more generous response to the request for statistics.

The total number of men employed in the production of building materials last year was 4,611, the amount of wages paid for labor was $1,168,240, and the value of materials produced was $2,378,611. In these statistics cement is not included. This industry employed last year 305 men, with wage earnings of $128,134, while the value of the product of their labor was $376,318. The number of workmen employed in brick and tile yards was 2,622, or nearly 800 more than in 1896. Separate statistics are given for pressed brick and terra cotta, and as will be seen there is little sign of revival in the production of these materials. Two or three of the works had been closed down owing to lack of demand for pressed brick, but work has been resumed at one or two of these and it is likely that the output of this year will show an increase. The number of men employed at the quarries last year was 1,250, or 480 more than in 1896. Brick and tile works are correspondingly active, and the output of the yards is but little short of the best year in the decade. The number of men employed at the works last year was 114, being 29 less than in 1897.

The statistics of lime production show an increase in proportion to those of other building materials, and very nearly approach the highest figures of the decade. The number of workmen employed last year was 548, or 118 more than in 1896.

The manufacture of sewer pipe last year gave employment to 77 men, whose aggregate wages were $26,260, as compared with 64 men and $19,600 for labor last year. The value of sewer pipe produced was $93,717, or $20,166 more than last year.

CEMENTS.

Very satisfactory progress continues to be made in the production of cement, but especially the Portland variety of it. There has been substantial improvement in the output of the natural rock cement works during the past four years, but values are not so well maintained as is the case with Portland cement, and the rate of increase is considerably lower in the number of workmen employed, in the amount of wages paid for labor and in the quantities produced. The following table gives the statistics of the industry for the last five years:

Natural rock cement— Schedule.	1894.	1895.	1896.	1897.	1898.
Number of works	5	5	5	4	4
Number of workmen.	63	45	56	70	85
Wages for labor	$13,020	$14,166	$15,200	$21,500	$23,784
Product, bbls	55,323	55,219	60,705	84,670	91,528
Value of product	$48,774	$45,145	$44,100	$76,123	$74,222
Portland cement—					
Number of works	3	2	2	2	2
Number of workmen.	105	129	120	161	220
Wages for labor	$31,858	$46,000	$48,400	$67,560	$104,350
Product, bbls	30,580	58,699	77,760	96,825	153,348
Value of product	$61,060	$114,332	$138,230	$170,302	$302,096

The average rate of wages in natural rock cement works rose from $207 to $315 during the period, and in Portland cement works from $303 to $451, while for both classes of works the aggregate of wages paid for labor grew from $44,878 in the first year to $128,134 in the last, being an increase of 185 per cent. The product of all cement works has grown from 85,903 barrels in 1894, valued at $109,834, to 244,876 barrels in 1898, valued at $376,318, being an increase of 173 per cent. in quantity and of 243 per cent. in value. There has been a slight fall in values per barrel, the average of natural rock being 88 cents in 1894 and 81 cents in 1898, while the average of Portland in 1894 was $2, and in 1898, $1.96. The statistics of Portland cement for 1898, it should be stated, includes 18,400 barrels of Silica Portland, valued at $32,200, which accounts for the apparent fall in value per barrel of Portland. But although the production of cement in Ontario is steadily growing larger, there is no falling off in the quantity of imports for all Canada. The following statistics show for the five years, 1894-8, the values of imports entered for consumption from Great Britain, the United States and other countries:

Year.	G. B.	U. S.	O. C.	Totals.
1894	$182,074	$33,263	$ 68,234	$284,471
1895	135,603	21,103	95,130	251,020
1896	121,125	25,007	107,007	255,020
1897	111,551	45,200	104,081	260,842
1898	100,548	50,855	200,574	300,977

It will be noticed that the trade has undergone a marked change in this short period of four years, the imports from Great Britain having fallen off from 64 to 29 per cent. of the whole, while those from the United States have increased from 12 to 16 per cent. and from all other countries from 24 to 55 per cent. of the whole. Practically all imports except those from Great Britain and the United States come from Belgium and Germany, the former having last year supplied cement to the value of about $150,000, and the latter to the value of about $50,000. The

* From the Report of the Bureau of Mines, Vol. VIII., 1st part, 1899.

amount of duty paid was $124,868.65, being $121,968.58 on Portland, and $2,900.07 on all other kinds. The total quantity imported last year, including what was not entered for consumption, was 1,153,040 cwt. of Portland, and 11,713 cwt. of other kinds.

POTTERY.

The pottery works of the province gave employment last year to an average of 164 men, whose earnings were $61,000. The value of products was $155,000.

PETROLEUM AND NATURAL GAS.

The total quantity of crude petroleum distilled last year was 26,978,977 imperial gallons, worth at the average price of crude $1,122,801. This was in quantity 1,422,386 gallons, and in value $55,753 more than for the previous year. During the first half of the year six refineries were in operation, owned by five separate companies; but during the second half the business was practically in the hands of two companies, viz., the Imperial of Petrolia, and the Bushnell of Petrolia and Sarnia, and it is now in one. The following table gives the quantities and values of distilled products for the years 1897 and 1898:

Products.	1897.		1898.	
	Gallons.	$	Gallons.	$
Illuminating oil.....	10,891,337	1,131,083	12,281,622	1,243,490
Lubricating oil	1,959,810	199,755	2,043,226	202,150
Benzine and naphtha.	949,341	77,340	1,240,967	121,840
Gas and fuel oils, tar..	8,021,633	281,035	8,047,441	286,705
Paraffin wax, candles..	2,139,278lb	88,378	2,616,086lb	116,349

In 1897 the total value of distilled products was $1,777,591, and in 1898 it was $1,970,534. In 1896 the value of distilled products was $832,187 more than the value of crude, being an appreciation by treatment of 74 per cent. In 1897 the appreciation was $710,463, or 67 per cent., and in 1898 it was $847,733, or 75½ per cent. Last year it was supposed that the lower rate of appreciation in 1897 was a result of tariff changes, but this view is not supported by the statistics of 1898. The average rate of wages was lower last year than in either of the previous years, being $482.68 against $540.83 in 1897, and $541.33 in 1896; but no doubt this is a consequence of a closing down of three of the plants in the latter part of last year. The average number of workmen employed at the refineries was 546, and the amount paid for labor $263,546. In 1897 the number was 364, and the amount paid for wages $196,965.70. The proportion of refined products obtained from the crude is shown in the following table for the seven years 1892-98, and indicates in a general way the progress that has been made in the processes of distillation during that period:

Product.	1892. p.c. of crude.	1893. p.c. of crude.	1894. p.c. of crude.	1895. p.c. of crude.	1896. p.c. of crude.	1897. p.c. of crude.	1898. p.c. of crude.
Illuminating oil...	38.67	39.12	41.10	43.31	45.08	42.62	45.52
Lubricating oil....	12.35	12.45	10.91	9.51	9.07	7.67	7.58
All other oils.....	27.34	28.14	30.45	28.07	31.09	35.10	34.42
Totals.....	78.36	79.71	82.46	80.89	85.24	85.39	87.52

In the seven years the increase of all refined products obtained from the crude has been 9.16 per cent., made up of 6.85 per cent. in illuminating oil, and 7.08 per cent. in all other oils except lubricating; in the latter there has been a decrease of 4.77 per cent. The wax product last year was larger than in 1897 by 476,808 lbs., and larger than in 1896 by 1,084,415 lbs. There is perhaps no other industry in the country in which such marked and satisfactory improvement has been made as in the oil industry, and those employed in it deserve great praise for the intelligent methods they have so diligently pursued.

A great deal of exploring and developing was carried on during the year for supplies of crude, and the situation was improved in consequence. A small field north of the London road in Sarnia township has been added to the producing territory. The southern part of the township of Plympton has also given good results, although in these two localities the oil deposit is not quite so uniform as in the old districts of Petrolia and Enniskillen. It was thought last summer that the township of Brooke gave evidence of a good deposit, and quite a number of wells were drilled there; but the supply did not prove to be permanent, and most of the wells have been abandoned. In the township of Zone, near Thamesville, the same experience was realized; several wells yielded liberally when first drilled, but the flow did not last. Bothwell is getting its producing limits as an oil field defined, and during the year its yield was little more than 6,000 barrels monthly. Euphemia and Dawn have each a small field, the area of which is being expanded by exploration. In the old territory, which runs from the southern part of the township of Sarnia in a southeasterly direction through Enniskillen by way of Petrolia, wells may be struck at nearly every attempt. Small detached areas in this region not previously explored give good returns, one of the best being near Oil Springs. It takes time, experience and risk of loss to discover these treasures of Nature's storehouse, but it is not improbable that anywhere throughout the counties of Lambton, Kent and Essex a discovery of oil may be made. A new locality that has recently been attracting attention as an oil field is in the southern part of Dunwich township, in Elgin.

CALCIUM CARBIDE.

For the thirteen months ending December 31, 1897, the product of the Willson Carbide Works Company at Merritton was 574 tons of calcium carbide, valued at $34,440, the average number of workmen employed being 30, and the amount of wages paid for labor, $12,544.62. Last year the product of the works increased to 1,040 tons, valued at $55,976, the average number of men employed was 35 and the amount of wages paid for labor was $16,397.95. The only interruption to operations during the year was caused by a cyclone which swept over the town and destroyed a number of buildings, among them being one of the power-houses of the company. The damage to the power-house was quickly repaired, however, and meantime the mill and furnace were run at a reduced capacity. The demand for calcium carbide continues to be very satisfactory, more indeed than the Merritton factory has been able to supply. But although this is the case the selling price at the works has been reduced by $6 per ton. Further reductions will no doubt be made when larger works are erected, and more experience is gained in processes of manufacture. Important advances are likely to be made during the present year as a result of recent methods and tests.

GRAPHITE AND MICA.

The graphite mine in Brougham township was worked during only six months of last year. In that time 300 tons of ore were raised, valued at $6,000. Ten workmen were employed.

Mica has been discovered at a number of points during the last few years, chiefly in Muskoka and Frontenac. At most of the properties however, operations have not got beyond the development stage, and the returns show that only one of them was a producer last year. The Stoness-Kent mica mine, which is on lot 4 in the thirteenth concession of Bedford township, produced 34 tons of mica, valued at $7,500. From 12 to 18 men were employed. Only small lots were taken out at other locations. Mica for boiler covering is growing actively in demand.

PIG IRON AND IRON ORE.

The following table gives the statistics of the Hamilton blast furnace for the three years it has been in operation:

Schedule.	1896.	1897.	1898.
Ore smelted, tons.....	51,138	37,492	77,023
Scale and mill cinder, tons...	5,883	5,350	8,614
Limestone for flux, tons.....	8,657	9,473	13,709
Coke for fuel, tons.....	30,348	27,810	50,407
Pig iron product, tons.....	28,302	24,011	48,253
Value of product	$353,780	$288,128	$530,780
Wages for labor	$ 47,000	$ 40,000	$ 61,476
Average workmen, No.....	125	130	130

The proportion of Ontario ores used in the furnace last year was 27 per cent. of the whole, being 20,968 tons, whereas in 1897 it was only eight per cent. Two mining companies, whose operations were carried on chiefly in Hastings county, raised during the year 27,400 tons, nearly all of which was shipped to

Hamilton. Its selling price at the mines is given in the returns as $48.875, or $1.78 per ton. At the furnace the value of Ontario ores smelted was $62,904.81, or $3 per ton, which is the same rate as for American ores. The value of mill cinder at the furnace was $17,229.22, of limestone for flux $11,039.44, and of coke for fuel $158,783.22. The total value of raw materials and labor at the furnace was $479,597.64, and the total value of pig iron product $530,789. At the iron mines an average of 100 men were employed whose wage earnings were $26,700, and the value of ore mined, computed at the selling price at the mines, was $48,875.

COPPER AND NICKEL.

There has been a stir in the copper and nickel mines during the past year, and a number of new properties have been developed. Besides the mines in the Sudbury district, several locations north of Lake Huron, in the vicinity of Bruce Mines, have been receiving the attention of prospectors and capitalists. The Joseph Powers Syndicate on the Missisaga river has sunk one or two shafts, the old mines at Bruce Mines have been unwatered with a view to the resuming of operations there, and a new company has been opening up large showings of ore at Rock Lake, in Coffin township (now called Aberdeen). This last venture has been acquired by a syndicate now organized as the Rock Lake Mining Company, with an authorized capital of $1,000,000. The locations are situated about 10 miles north of Bruce Mines station, and comprise an area of 1,400 acres. The vein has been traced on the property for a length of three miles, and samples of float ore may be picked up to the south of it a long distance. Work was commenced in April of last year upon an outcropping of ore about 300 feet above the level of Rock Lake, and two adits 1,200 feet apart have been driven in from opposite sides of the ridge which holds the vein that prove its thickness to be 16 to 17 feet. A shaft is in course of being sunk, and test pits have been dug at various points, which indicate that the vein is well mineralized throughout its whole length. Work has also been resumed on Michipicoten island, where native copper occurs in amygdaloid trap and conglomerate, but although good samples are shown and rich outcroppings have been discovered, enough work has not yet been done for a judgment to be formed of their extent and value. In the township of Garson, about ten miles north of Sudbury, a copper-nickel deposit was opened last year, and a furnace to smelt the ore was in course of construction. North of Markstay station also active development work has been carried on and extensive bodies have been exposed, some of which carry gold as well as copper and nickel. The Canadian Copper Company, however, is the principal operator, and several new mines have been developed by this company. The following table shows for the seven years, 1892-98, the quantities of ore raised and smelted in the Sudbury district, and the per cent. of metallic contents in the ore smelted each year:

Year.	Ore raised. Tons.	Ore smelted. Tons.	Per cent. of metallic contents in ore smelted. Nickel.	Copper.	Cobalt.
1892.....	72,340	61,924	3.36	3.10	.1007
1893.....	64,043	63,944	2.21	2.38	.0800
1894.....	112,037	87,916	2.02	3.14	.0721
1895.....	75,139	86,546	2.67	2.73	.....
1896.....	109,007	73,505	2.67	2.54	.....
1897.....	93,155	96,093	2.68	2.86	.....
1898.....	123,920	121,924	2.28	3.13	.....

The total quantity of ore raised in the seven years was 650,040 tons, and the quantity smelted 591,852 tons. Last year's output alike of the mines and smelters was considerably more than in any previous year. It will be noticed that the increase in ore smelted has been almost steadily continuous from year to year, and while last year's record was more than 25 per cent in excess of the previous year it was nearly 100 per cent. more than in 1892. The percentage of nickel contents is fairly well maintained, but the percentage of copper was higher last year than in any one of the seven years.

The total number of workmen employed last year was larger than in any previous year excepting 1892 and 1894, and the amount of wages paid for labor was larger than in any year excepting the first. The aggregate amount of wages paid for labor in the seven years was $1,929,894, or an average of $489.45 per year; for last year the average was $493.74, which is higher than for any of the other years excepting 1893 and 1896. In the seven years the quantity of ore smelted was 591,852 tons, which on being reduced to matte gave 80,929 tons ordinary, and 4,233½ bessemerized matte, or in the proportion of 100 to 14.38. The estimated metallic contents of matte product in the seven years are 14,852½ tons, or 29,705,000 lbs. nickel; 17,285¼ tons, or 34,570,500 lbs. copper, and 30¾ tons, or 61,500 lbs. cobalt. At the selling price of matte at the furnaces, which is the form in which it is exported to the refineries, the total value of nickel product for the seven years has been $3,294,060, of copper $1,302,805, and of cobalt $14,613, or a total of $4,611,478. The selling value of last year's product was $782,300, the estimated quantities being 4,567,500 lbs. nickel and 8,373,500 lbs. copper. Comparative values of the metallic contents of the matte based on the selling price at the works are given for the seven years in the next table:

Year.	Nickel		Copper		Cobalt	
	per ton. $	per lb. cents.	per ton. $	per lb. cents.	per ton. $	per lb. cents.
1892.....	283.81	14.190	119.90	5.995	436.82	21.841
1893.....	275.08	13.754	80.50	4,025	494.73	24.736
1894.....	238.36	11.918	71.23	3.561	461.54	23.077
1895.....	174.83	8.741	68.02	3.401	.....	.....
1896.....	183.22	9.166	69.94	3.497	.....	.....
1897.....	179.91	8.995	72.75	3.637	.....	.....
1898.....	184.72	9.236	64.02	3.201	.....	.....

These figures show a slight rise in the value of nickel compared with the averages of the previous three years, but a large decrease compared with the first three years of the period. In the case of copper the lowest point of the period was reached last year, although the price of copper had gone up to a point not reached during many years. Obviously the value should be considerably higher than it appears.

GOLD AND SILVER.

Gold was produced last year at 17 locations, but as only four of these have reported an output in excess of $20,000 it will be readily understood that a large majority of them are yet only in the early prospecting stage. The leading ones are the Sultana, the Mikado, the Regina and the Belmont. The Regina however was closed down for five months, during reconstruction of the mill. The Foley was also idle for the greater part of the year, pending a sale of the property in England. In the eastern part of the province the Belmont and Deloro mines promised well at the beginning of the year, but unfortunately the mill of the Deloro was destroyed by fire early in the spring, and a new one erected in its stead was not completed until the close of the year. Both of these mines give assurance of good results for the present year, and in the west the outlook is very hopeful. The following table gives the statistics of gold mines and mills in the province for the five years, 1894-98:

Schedule.	1894.	1895.	1896.	1897.	1898.
Mines worked	4	8	8	9	17
Men above ground	40	126	103	222	290
Men under ground	52	111	86	210	284
Ore treated, tons..	2,428	6,500	13,202	27,589	57,895
Gold product, oz..	2,022½	3,038	7,154	11,412	16,201
Gold value $32,776	$50,781	$121,848	$190,244	$275,078
Labor wages paid..$38,032	$56,234	$91,210	$217,760	$290,010

The total quantity of ore milled during the seven years, 1892-98, has been 116,074 tons, and the value of gold product was $740,587, being an average of $6.33 per ton. This is proof of the low grade character of the ore, but as nearly all of it is free milling, it is high enough to earn a good margin of profit when development is sufficiently advanced to provide an ample quantity to keep the mills running steadily. It will then be possible to select the ore, instead of treating all that comes from the mines. Therefore an increase of average may reasonably enough be looked for, unless, as seems likely, some extensive low grade deposits are worked on a large scale.

THE PRACTICAL MAN.

LUBRICANTS FOR CUTTING TOOLS.

Material.	Turning.	Chucking.	Drilling.	Reaming.	Tapping Milling.
Tool Steel...	Dry or Oil	Oil or Soda Water	Oil	Lard Oil	Oil
Soft Steel...	Dry or Soda Water	Soda Water	Oil or Soda Water	Lard Oil	Oil
Wro'ht Iron	Dry or Soda Water	Soda Water	Oil or Soda Water	Lard Oil	Oil
Cast Iron...	Dry	Dry	Dry	Dry	Dry
Brass	Dry	Dry	Dry	Dry	Dry
Copper	Dry	Dry	Dry	Mixture	Dry
Babbitt	Dry	Dry	Dry	Dry	Dry

Glass.....Turpentine or Kerosene.

Mixture is one-third crude petroleum and two-thirds lard oil. When two lubricants are mentioned the first is preferable. Oil is sperm or lard; sperm is preferable.

To Harden Cast Iron.—Many times it is very convenient to make an article of cast iron that needs to be finished, and which should be very hard. Cast iron can be hardened as easily as steel, and to such a degree of hardness that a file will not touch it. Take one-half pint vitriol, one peck common salt, one-half pound saltpetre, two pounds alum, one quarter pound prussiate potash, one-quarter pound cyanide potash; dissolve in ten gallons soft water. Be sure that all the articles are dissolved. Heat the iron to a cherry red, and dip it in the solution. If the article needs to be very hard, heat and dip the second and even the third time.

Annealing Cast Iron.—To anneal cast iron, heat it in a slow charcoal fire to a dull red heat; then cover it over about two inches with fine charcoal; then cover with ashes. Let it lie until cold. Hard cast iron can be softened enough in this way to be filed or drilled. This process will be exceedingly useful to iron founders, as by this means there will be a great saving of expense in making new patterns.

To make a casting of precisely the same size of a broken casting without the original patterns.—Put the pieces of broken casting together and mould them, and cast from this mould. Then anneal it as above described; it will expand to the original size of the pattern, and there remain in that expanded state.

How to Anneal Brass or Copper.—In working brass and copper, it will become hard, and if hammered to any great extent will split. To prevent cracking or splitting, the piece must be heated to a dull red heat and plunged in cold water; this will soften it so it can be worked easily. Be careful not to heat brass too hot, or it will fall to pieces. The piece must be annealed frequently during the process of hammering.

The Relative Weight of Different Metals.—The weight of wrought iron being 1, cast iron will be .95, steel 1.02; copper 1.16, brass 1.09, and lead 1.48.

Weight of Castings.—If you have a pattern made of soft pine, put together without nails, an iron casting made from it will weigh sixteen pounds to every pound of the pattern. If the casting is of brass, it will weigh eighteen pounds to every pound of the pattern.

A metal that will expand in cooling is made of 9 parts lead, 2 parts antimony, and 1 part bismuth. This metal will be found very valuable in filling holes in castings.

Lead Explosions.—Many mechanics have had their patience sorely tried when pouring lead around a damp or wet joint to have it explode, blow out or scatter from the effects of steam generated by the heat of the lead. The whole trouble may be avoided by putting a piece of resin, the size of a man's thumb, into the ladle and allowing it to melt before pouring.

Glue.—A little powdered chalk added to common glue makes it much stronger; and a glue that will resist the action of water may be made by using skimmed milk instead of water. A few drops of vinegar put in mucilage will keep it from spoiling.

To Sharpen Reamers.—Hand reamers, when dull through wear, should be stoned first on the face of the flutes, then on top of the flutes. The stone should be always held perfectly flat with the face and clearance that the original shape of the flutes may be preserved. End cutting reamers should be first turned on centres with a wheel, and then recleared to insure reaming a hole the same size of reamer. The Norton Emery Wheel Co. makes an emery stone for the purpose, which is well adapted, and is said to give quicker results than any oil stone. The stone should be kept clean by the use of turpentine.

ICE BREAKING.

There was built last year in the shipyards of Sir W. G. Armstrong, Whitworth & Co., an ice-breaking steamer for the Russian Government, designed by Vice-Admiral Makaroff, and her business is to be to keep some of the principal ports of the Baltic open during the winter. From "Engineering" we take the following account of her first voyage:

Admiral Makaroff first met the ice in the Baltic. It was drift ice, apparently about five feet thick, and judging by the report of Mr. Gulston, of Newcastle, who accompanied Admiral Makaroff on his voyage, there seems not to have been the slightest difficulty in getting the "Ermack" through this obstruction, as she went comparatively easy at nine knots, the engines working slowly. Before going into the ice the engines had been slowed down to ten knots, so as to reserve the powers of the engine-room staff for the harder work which was to come. The worst piece of ice which was encountered was estimated at twenty-five feet thick, and the ship went nearly through this formidable obstruction before she was brought up by it. Accurate measurements were taken as soon as possible and the report reads that the field ice was five feet in thickness, the pack on top was nine feet, and there was ice below the field amounting to eleven feet, so far as could be measured, but there may have been more, as there was no means of measuring further below the bottom of the field. It was evident that a large mass of ice had been washed off a shoal and frozen on the field. The worst field ice that they had much of was apparently four feet thick, with snow on top of it. The snow seems to be the greatest impediment to the vessel's progress, as the designers of the ship had always been led to expect. Mr. Gulston reports that twelve inches of snow was a serious impediment, and eighteen inches almost blocks her. This is, of course, on the top of thick field ice. The ice generally in the Baltic seems to have been much more serious this winter than was expected, and it is said to be beyond 1883, which we gather was a record winter. The "Ermack" did not run continuously, but rested at night and started early in the morning, working with the searchlight. There was apparently no difficulty in starting, although the ship had become fast in the ice. Ice anchors were put out, and the vessel was warped backwards from her berth, after which she started without difficulty. One of the most satisfactory features is that she steers, as Mr. Gulston says, "In any way, at any time, in any ice." This has never been the case with any ice-breakers that have previously been built, and is no doubt due largely to the form of the ship, for there is no flat place on her side, either vertically or horizontally, so that unless absolutely frozen in solid she can be given some movement, and can thus be worked loose by her own propellors and by ice anchors laid out. Her arrival at Cronstadt was evidently an extraordinary sight. The ice was about eighteen inches thick, with a good deal of snow on the top, and the ship steamed through this at six and a half knots up to the sea wall and past the battleships. She swung around on the port hand and entered the harbor through an entrance only ninety five feet wide; the ship itself is seventy-one feet beam. She swung once in the inside harbor, and one charge astern put her into her berth alongside the coal store. Some manœuvering trials were made in ice of about two feet to three feet in thickness when the turning circle was found to be about six hundred feet, and there was apparently very little difference in which direction the ship was turned. The effect of the bow propellor was most marked, and it seems practically to be that if the bow propellor is stopped, the ship stops, too.

Mr. Gulston examined the ship both inside and outside, as far as he could, and could find absolutely no sign of weakness. The outer skin has been polished bright where the vessel has been running through the ice; but there is no sign of breakage anywhere. The ice varied enormously in quality. Drift ice was passed through, and appeared to offer practically no impediment; pieces described as quite two to three acres in extent were pushed aside, the ship moving through quite easily. Pack ice with eighteen inches of snow on top, seems to have been the greatest difficulty.

The " Ermack " is 305 feet long, 71 feet beam, and 42 feet 6 inches deep. She is capable of developing 12,000 horse-power, and of making 16 knots an hour. She has four screws, all four bladed, and varying in diameter from 13 feet to 14 feet 6 inches. The blades are enormously thick, and made of very strong cast-steel, are calculated to be brought up by the ice when the vessel is running at full speed without breaking. The draught of the vessel is calculated to be 19 feet, in fresh water, and 25 feet when working in the Kara Sea, with 3,000 tons of deadweight. The screws are arranged, three at the stern and one at the bow.

Reference should be made to the arrangements for coupling up this ship with another or others, in order to make a train of ships for more effectively dealing with thick ice. Although the " Ermack " is so big and strong a ship, there is, of course, a limit to her capacity of breaking up ice, and to the speed with which she could perform the operation. A vessel pushing astern of her would supply additional power to do the work. Forward the stem is set at an angle of seventy degrees from the vertical. So in going through the ice she would slide up, raising her bow, and this would cause the ice to break down. She might, of course, mount the ice until her forward propeller came into contact with it; but, as has been said, this is made of sufficient strength to stand the shock. That, however, is not what is expected generally to occur, as the form of the bow is designed to keep breaking down the ice continuously. Of course this would absorb an enormous amount of power; but if another vessel, either an ice-breaker or an ordinary steamer, were pushing astern, naturally the speed would be increased. Moreover, a vessel not so strongly built as the " Ermack " would be protected by following close behind her. For this reason a recess has been built into the counter of the ship. This recess is designed to take the stem of the following vessel, arrangements being made for lashing the latter in firm contact with the leading craft. It may be mentioned that the " Ermack " has also a specially strong towing windlass abaft.

ACCIDENTS OF THE MONTH.

An explosion occurred in the Blockhouse, N.S., gold mines, Sept. 13th, resulting in the death of one man and the serious injury of another.

S. Gagnon, a young apprentice in Gilmour & Hughson's sawmill at Ottawa, was killed while attempting a horizontal bar act on a fast revolving shaft which turns beneath the mill.

H. Dooley, Division street, Ottawa, 25 years of age, a mill-hand at J. R. Booth's sawmills, while at work, Sept. 14th, was caught between two rolls six inches apart and drawn in front of a five-foot circular saw, and was mangled in such a way as to die shortly afterwards.

J. Benoit, about forty years of age, living at 18a Soulanges street, Point St. Charles, Montreal, was killed instantly at the G.T.R. shops, a short time ago. He was struck violently on the chin and side of the head by some machinery operated by shafting, and his brains scattered.

W. A. M. Pollock, electrician, in the employment of the Almonte, Ont., Electric Light Company, met with a fatal accident, Sept. 18th. While working with a large driving belt he was caught and drawn into the wheels. One arm was torn from his body at the elbow, and he was hurt internally. He died two hours later. It took over an hour to extricate him.

TORONTO EXHIBITION NOTES.

D. K. McLaren, leather belting and mill supplies, Montreal and Toronto, had a fine exhibit of various kinds of belting, and a great variety of textile and other mill supplies.

The Still Motor Co., successors to the Canadian Motor Syndicate had two storage battery vehicles in the Machinery Hall, and one in constant operation through the grounds.

The Royal Electric Co., Montreal and Toronto, had the whole of the eastern end of the central tier of exhibits, where a great aggregation of motors, transformers, dynamos, meters and switch boards were shown. Among these was a 3,000 light machine and a 2,000 light and 1,500-light machine all of which were sold. It was the most comprehensive exhibit in the line of the electric line.

The Northey Mnfg. Co. had a small building all to themselves, near the western entrance to Machinery Hall, where several of their well-known Imperial gas engines were in operation, and attracted a large number of investigators.

The Robb Engineering Co. had an exhibit of the celebrated Robb-Armstrong engines, which are now known not only all over Canada, but in many foreign countries, where they have gained acceptance in competition with the best makers in the world.

The Dodge Mnfg. Co., manufacturers of pulleys, had an imposing trophy formed of their celebrated wood split pulleys, which were also to be seen in actual use on many other exhibits. This company are the largest manufacturers of wood pulleys under the British flag.

A. W. Spooner, of Port Hope, " the handsomest town in Canada, and the only place in the world where Spooner's copperine is made," had a striking display of copperine. The genial owner of this metal reports that it continues to grow in popularity among engineers.

The Northey Mnfg. Co., are showing gas and gasoline engines in great variety. Machinery Hall exhibit contained a combination gasoline or gas engine, which is used for operating a pump. To the right of the western entrance they had a building in which the bulk of their exhibit commanded much attention from the visitors.

Cowan & Co., of Galt, only showed wood working tools although they manufacture the Corliss pattern of engine. They publish a very complete catalogue showing the different styles made by them. Their exhibit comprised 12-in. moulders, planers and matchers, band saw filers and " Clark " pattern band saw set, and one power feed rip saw. The Cowan people are advocates of the fast gear type of machine gearing, and their arguments are interesting and instructive.

Just outside the east end of Machinery Hall was a complete exhibit of road-making machinery shown by the Good Roads Machinery Co., of Hamilton. It consisted of a Champion rock crusher, a road roller, a mud scraper, a road grader and road ploughs. Mr. Challen, the manager, was always surrounded by an interested crowd of enquirers. He reported that the Government of New Brunswick had adopted the Good Roads Machinery Co.'s system, their latest order being a No. 4 mounted crusher, a 12-ton steam roller, a McAdam spreading wagon, and other machinery.

One of the most attractive exhibits was that of the Jones & Moore Electric Co., of Toronto. They exhibited a complete line of electric motors up to 40 h.p., as well as several direct current dynamos, enclosed arc lamps, telephones for private lines, etc. This firm make a specialty of lighting and power plants for factories and mills. Some of the plants on order and installed are: D. S. Perrin & Co., London, 400 light dynamo; N. R. Williams Co., Montreal, 80 light dynamo; Gadsby & McCann, Toronto, 20 h.p. motor; Massey-Harris Co., Toronto, 20 h.p. motor; Meaford Woolen Mills, 80 light dynamo; Toronto Grain and Seed Cleaner Co., Toronto, 20 h.p. motor; McFarland, Gray & Southgate, Toronto, 8 h.p. motor. They now have over 500 machines in daily operation.

In Machinery Hall this year power was supplied to the line shafting and individual machines by different makes of engines. The Corliss type, the well known Wheelock and the Ideal; one of the Wheelock 100 h.p. being the purchase of the Industrial Fair for Machinery Hall. The Still Motor Company exhibited one of their motor carriages, and the company have, owing to the great number of orders, been unable to spend time in preparing exhibition goods. One of the features of Machinery Hall was the Hardill tandem compound engine exhibit. This new engine was patented in Canada in January, 1899. A company has been formed in Mitchell, Ont., to manufacture them. The engine exhibited was 5 in. H.P. and 8½ in. L.P. cylinders, and 7-in. stroke. In January and February of this year Prof. J. T. Nicolson, of McGill University, tested the economy of this engine and made a report on April 14th, 1899, a copy of which can be procured upon request. According to the report the engine showed 21½ i.h.p. working double acting. Prof. Nicolson says: " I am surprised at the economy shown by so small an engine. It is accounted for by the compounding of the expansion and the high speed."

At the close of the Exhibition a number of the exhibitors in the machinery hall met and presented Thomas Eversfield, the chief engineer, with a handsome bedroom suite in oak. The gift was accompanied with an address expressing the donors' appreciation of Mr. Eversfield's attention to the exhibits during the fair.

Rice Lewis & Son, Ltd., of Toronto, are to be complimented on the large and artistic display of parlor mantels, grates, tilings, railings and other interior house fittings. A tiled bath-room and two or three parlors were represented, and each exhibit was in excellent taste. The rooms were filled with an admiring crowd each day, and the display was voted the best of the kind in the Exhibition.

The Mica Boiler Covering Co., not content with having a boiler and a range of piping covered with their mica covering in the Machinery Hall, had their covering placed on several engines in other parts of the grounds where engineers could test for themselves the remarkable properties of mica for this purpose. All the pipes connected with the motive power in the Machinery Hall were covered with this material, which received much favorable comment.

The Luxfer Prism Co. had a long dark gallery built, in one end of which was a swinging window fitted with Luxfer prisms. It was a source of never ceasing wonder to the thousands of visitors here that when the window was closed the whole gallery was lighted from end to end with a soft light, in which the colors of every object could be distinguished; but when the window was opened to the full light of the sky there was comparative darkness through the gallery, and no colors could be made out in the placards on the rear wall. As a means of shedding light in dark places everybody admitted that Luxfer prisms were a remarkable discovery.

LITERARY NOTES

The Daily Review is a new paper, which reaches us from St. John's, Newfoundland. This will be a welcome addition to the journalism of Great Britain's oldest colony in America.

Glaziers' diamonds of every known style and type are illustrated in the catalogue of A. Rudd & Co., St. Helens, Lancashire, Eng. This concern also makes nippers, vises, atmospheric soldering irons, and other tools for the manipulation of sheet, plate and stained glass work. Messrs. W. J. Woodburn & Sons, Montreal, are Canadian representatives.

The interesting history of the "Beginnings of the St. Lawrence Route," by Arthur Weir, B.Ap.Sc., Montreal, which recently appeared in The Canadian Engineer, has been reprinted in pamphlet form. Mr. Weir has gathered a great amount of hitherto unpublished matter in this essay, and has presented it in such an attractive form that many will be glad to have it in this convenient form for future reference. Although the edition is a very limited one the price is only 10 cents per copy.

The Quebec and Lake St. John Railway have published some books descriptive of the scenery on the line of their well known road, which also contain many good illustrations of the sportsman's variety. The names of the books are as follows: "Guide to the Lake St. John and its Tributary Waters;" "Ye Ancient Quebec," and "A Tale of Lake St. John." Any or all of these will be sent to any person interested. Their time tables are original in design, and much more complete in information and description than the ordinary run of railway folders.

Few people, except those who have made a special study of Canadian books, would believe that a mere catalogue of Canadian poets and their works would make a volume of 72 pages, and contain about 500 names. Such, however, is the array of Canadian versifiers presented by C. C. James, the Deputy Minister of Agriculture for Ontario, in a work just compiled by him for the Victoria University Library. Mr. James recently presented the University with what is probably the largest library of Canadian books of poetry yet collected, and this bibliography is his crowning tribute to the poetical literature of the country. It is from the press of William Briggs.

—A steel bridge will be erected over the Pembina River near Riviere, Man., to cost about $3,000. Another steel bridge will be built over the same river 20 miles south of Manton.

QUEBEC ARCHITECTS' ASSOCIATION.

The annual meeting of the Provincial Architects' Association was held in Quebec city, Sept. 23. A. Raza, president, was in the chair, and presented the annual report, which states that the association now numbers 139 active members, of whom ten joined during the year. The meeting elected the following officers for the ensuing year: President, S. H. Capper; vice-president, G. E. Tanguay; second vice-president, Joseph Venne; secretary, G. O. Monette; treasurer, W. A. Doran; council, Messrs. A. Raza, J. S. Archibald, E. Maxwell, A. Chausse, H. Staveley and A. H. Lapierre. The next meeting of the association will be held in Montreal in September, 1900.

THE GREAT LAKES COPPER CO.

Much interest is being taken by everyone realizing the value of the mineral industries to Canada in the plant now being established at Sudbury for treating the nickel-copper ores of that district by the Great Lakes Copper Co., of Sudbury, Ont. The president of the company is Jno. McKinley, 60 State street, Boston, and the superintendent is C. M. Boss. The plant is now in process of construction, and is to a certain extent experimental. The process is being patented in Canada, and when the necessary formalities have been completed this journal will publish a more extended notice of it. The great advantage attained by the use of the process of the Great Lakes Copper Co. is a reduction in the time of ore treatment. In fact it is said that instead of weeks only three days is required to produce nickel of 60 per cent. fineness from the ore.

GOOD WORK APPRECIATED.

The Canadian Engineer has a splendid report in this week's issue of the C.A.S.E. convention held in Berlin in August. The report is very full and accurate, and every engineer should obtain a copy. Mr. Smith, The Canadian Engineer's representative at the convention, deserves credit for the manner in which he looked after C.A.S.E. interests.—The News-Record, Berlin, Ont.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain of interest to the metal trades in August, 1898-99, and the eight months ending August, 1898 and 1899:—

	Month of August.		Eight Months ending August.	
	1898.	1899.	1898.	1899.
Hardware	£2,115	£2,025	£14,617	£13,170
Cutlery	5,043	4,149	35,841	33,766
Pig iron	1,007	1,743	8,113	8,815
Bar, etc.	229	2,880	6,271	10,969
Railroad	—	1,363	6,972	58,591
Hoops, sheets, etc.	12,095	12,852	36,122	68,307
Galvanized sheets	7,270	4,643	39,341	40,117
Tin plates	12,571	20,175	96,169	118,266
Cast, wrought, etc., iron	1,454	7,903	16,662	32,315
Old (for re-manufacture)	—	421	3,574	2,424
Steel	2,542	9,134	35,185	52,760
Lead	3,668	5,111	19,726	32,440
Tin, unwrought	652	1,773	11,875	14,215
Alkali	3,139	2,850	27,558	21,508
Cement	2,671	2,700	14,824	18,939

—A Washington special to The Detroit Free Press says the United States War Department has referred the protests of their Lake Carriers' Association against the construction of the canal through Kent county, Ontario, connecting Lake St. Clair with Lake Erie, to Col. Leydecker, with the request for a full investigation and a report. Col. Leydecker will report both as to the probability that the project will find adequate financial support, and as to its effect upon the level of the lakes, should it be carried out. It seems probable that if it is found that the Canadian project is being seriously considered with any prospect of its being actively entered upon in the near future, the State Department will take the matter up with the Canadian Government on the basis of a proposition to appoint a commission which was earnestly advocated by Col. Leydecker and his colleagues in their report on the Sault power canal.

NICKEL EXTRACTION BY THE MOND PROCESS.*

BY SIR. WILLIAM CHANDLER ROBERTS-AUSTEN.

The rules of the institution provide that an associate shall submit a paper within a year of his election. In complying with this direction, the author was satisfied that no better subject could be selected for consideration than the interesting process which marks an entirely new departure, in metallurgical practice, from the principles which have hitherto guided it. This process depends on the remarkable property possessed by nickel of forming a volatile compound with carbonic oxide, or, as it is called in modern chemical nomenclature, carbon-monoxide. When this gaseous compound is heated to 180° C. nickel is released in the metallic form.

The author was much impressed during a recent visit to Canada with the imperial importance of the great nickeliferous district of Sudbury, Ontario. In view of the magnitude of this deposit, the annual production of metallic nickel in Canada seems inadequate, as it has hitherto not exceeded 2,750 tons. The description therefore of any new process which affords a hope of hastening the development of this remarkable district should prove to be interesting. The deposit itself presents many points of interest. According to Professor Coleman, of Toronto, the nickel ores of Ontario resemble the gold ores of Rossland in British Columbia, as they consist of a mixture of pyrrhotite (magnetic pyrites) and copper pyrites. These sulphides form enormous masses near the margin of large areas of diorite, or weathered gabbro of Huronian age, the amount of nickel contained in the ore averaging between 2½ per cent. and 10 per cent., the lower proportion being the more common. It is worthy of note that pyrrhotine from other parts of the country, found in association with Laurentian rocks, is almost barren of nickel. The importance of the nickel deposits of Ontario may be judged from the fact that, until the mines in the Sudbury region were worked, the world's supply of the metal was drawn chiefly from the mines of New Caledonia, an island in the Southern Pacific, supplemented by the Gap mine in Pennsylvania, and a few isolated mines in Norway and Hungary. The extent of the Sudbury deposits is greater than any of these, and New Caledonia, which belongs to France, is virtually the only rival of Ontario in the production of nickel.

The ore at Sudbury is smelted into a regulus, or matte, which contains between 12 per cent. and 20 per cent. of nickel, and about the same amount of copper, although usually there is rather more copper than nickel. This matte may be enriched by suitable treatment, and is "bessemerized" into a regulus which contains about 40 per cent. of nickel, and is especially free from iron, as the following analyses show:

	I.	II.
	Per cent.	Per cent.
Nickel	40.938	31.35
Copper	45.714	48.80
Iron and (Al_2O_3)	0.405	0.81
Cobalt	0.130	.....
Sulphur	11.900	...

It is unnecessary to give a history of the metallurgy of nickel, but it may be well to state that Chronstet isolated the metal in the year 1751, and that Bergman confirmed his discovery in 1774. The methods hitherto employed for extracting the metal from its ores are very complicated; they have involved concentrating the nickel either as a sulphide (matte or regulus), or as arsenide (speise) followed by either "dry" or "wet" treatment. In the case of certain ores, wet methods only have been employed. The metallic nickel has always to be subjected to a process of refining, mainly, as in the case of cast iron, with a view to separate it from associated carbon.

As regards the process which forms the subject of this paper a few brief historical details may be offered. In 1889 Dr. Ludwig Mond, F.R.S., in collaboration with Dr. Carl Langer, was engaged in working out a method for eliminating the carbon monoxide from gases containing hydrogen which they wanted for use in their gas battery.[2] In attempting to effect this, they were guided by the observation they had previously made that finely divided nickel has the remarkable property of removing carbon from carbon-monoxide at a temperature of 350° C., converting it into carbon-dioxide, while the dissociation of carbon monoxide by heat alone, according to Victor Meyer and Carl Langer, remains incomplete at the high temperature of 1,090° C. In the course of these experiments, which they carried out in conjunction with Dr. Friedrich Quincke[3], finely divided nickel formed by reducing nickel oxide at 350° C., by hydrogen, was treated with pure carbonmonoxide in a glass tube at varying temperatures. In order to keep the poisonous carbon-monoxide out of the atmosphere of the laboratory the gas escaping from the apparatus was ignited. They found to their surprise that while the tube containing the nickel was cooling, the flame of the escaping gas became luminous and increased in luminosity as the temperature sank below 100° C. Metallic spots were, moreover, deposited on a cold plate of porcelain held in this luminous flame, just as spots of arsenic are obtained in applying the Marsh test for that metal. It was also observed that on heating the tube through which the gas was escaping, a metallic mirror was obtained, while the luminosity of the flame disappeared. On examination these metallic deposits were found to be pure nickel. The next step was to endeavor to isolate this curious and interesting nickeliferous compound, by preparing nickel with great care at the lowest possible temperature, and treating it with carbon-monoxide at about 50° C. The amount of the volatile nickel compound in the gases passing through the apparatus was thus gradually increased. The gases issuing from the apparatus were treated with a solution of cuprous chloride to absorb the excess of carbon-monoxide, and in this way a residue of several cubic centimetres of a colorless gas was obtained, containing the volatile nickel compound. By passing this gas through a heated tube the nickel and carbon-monoxide were again separated, and the volume of the carbon-monoxide thus set free was found to correspond to about four equivalents of carbon-monoxide to one equivalent of nickel. By further improving the method of preparing the finely divided nickel, and by passing the resulting gases through a refrigerator cooled by snow and salt, the investigators at last succeeded in obtaining the new compound in a liquid state, and were able to produce it with facility in any desired quantity.

Nickel carbonyl in its pure state is a colorless liquid boiling at 43° C.; it has a specific gravity of 1.3185 at 17° C., and solidifies at —25° C. into needle-shaped crystals. It is soluble in alcohol, petroleum and chloroform; and it is not acted upon by dilute acids or alkalies. It can be readily distilled without decomposition, but on heating the vapor to 150° C., it is completely dissociated into its components, pure carbon-monoxide being obtained, while the nickel is deposited in a dense metallic film upon the sides of the vessel in which the compound is heated.

After the production of nickel carbonyl had become easy, Drs. Mond, Langer and Quincke directed their attention to the action of carbon-monoxide on other metals. A series of experiments was made with a view to obtain a similar compound with cobalt, which in its chemical and physical behavior so much resembles nickel. The experiments gave, however, the unexpected result that, unlike nickel, cobalt will not combine with carbon-monoxide. Experiments were then made with iron and indications were soon obtained of the existence of a volatile compound of iron and carbon-monoxide; a long time elapsed before this new compound was obtained in a pure state. It was finally isolated in a way similar to that by which the nickel carbonyl had been prepared, and proved to be a somewhat viscous liquid of pale yellow color[4]. Its specific gravity at 18° C. is 1.4664; and it distils completely without decomposition at 102.8° C. under a pressure of 730 millimetres of mercury. When cooled to —21° C. it solidifies into a mass of yellowish needle-shaped crystals. Its chemical composition is somewhat different from the nickel carbonyl, as it contains five equivalents of carbon monoxide to one of iron. The liquid compound, to which the name of iron penta-carbonyl was given, undergoes no change when protected from the action of light, but exposure to daylight for several hours in a sealed tube is attended with the formation of gold colored tabular crystals, and carbon-monoxide is evolved, so that the pressure in the tube rises con-

*This paper on the Mond Process by Sir. W. C. Roberts-Austen, D.C.L., F.R.S. was read before the Institution of Civil Engineers, London, England, on 8th Nov. 1898.

[2] Ludwig Mond and C. Langer. Improvements in obtaining Hydrogen," British Patent No. 17,768, 1889.

[3] Ludwig Mond and C. Langer. "A new form of gas battery." Proceedings of the Royal Society, vol. xlvi, p. 296.

[4] Ludwig Mond, C. Langer, and F. Quincke. Journal of the Chemical Society, vol. lvii., p. 749.

[4] Ludwig Mond and Carl Langer on "Iron Carbonyls." Journal of the Chemical Society, vol. lix. p. 1090.

siderably. The crystals have, when dried, a metallic lustre, and resemble flakes of gold; they contain two equivalents of iron to seven equivalents of carbon-monoxide. None of the other metals which were submitted to investigation showed indications of combining directly with carbon-monoxide.

The discovery that in a mixture of metals only nickel and iron would form volatile compounds with carbon-monoxide, and that they could, therefore, be separated from the other metals, was sufficiently important to induce Dr. Mond to arrange laboratory experiments with ores containing nickel, cobalt, iron, copper, etc., such as "kupfer-nickel" and "pyrrhotite." The experiments afforded such promising results, that apparatus of considerable size, though still well within the limits of the resources of a laboratory, was set up, and in it several pounds of ore could be treated with carbon-monoxide.[5] A patent was also applied for on the 12th August, 1890, which describes the way in which such ores may be treated. It is pointed out that the principal nickel ores which are metallurgically treated contain the nickel in combination with arsenic and sulphur besides other metals and gangue. These ores have first to be submitted to the process of calcination, in order that the nickel may be present in the form of oxide, and to drive off, as far as is practicable, the arsenic, sulphur, and other volatile bodies. The resulting oxide of nickel is treated with reducing gases, such as water-gas or producer-gas, in order to convert the oxide of nickel into finely divided metallic nickel; the material containing it then is cooled to about 50° C., and is treated with carbon-monoxide. In dealing with nickel ores which contain

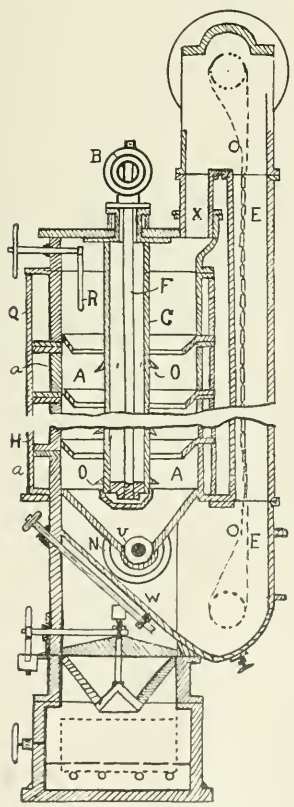


FIG. 1

nickel oxide in chemical combination with silicic acid, arsenic acid, or other substances which cannot be removed by calcination, the ores are so treated as to convert the nickel into nickel speise or nickel matte, which is then subjected to calcination.

In 1892 an experimental plant on a large scale was erected at Smethwick, near Birmingham. After some years of patient work, during which the plant had several times to be reconstructed, in order to meet all the conditions of this somewhat delicate process, the plant gradually assumed the shape shown in Figs. 1. Before describing it in detail it will be well to give a brief account of the operations involved in the process, which are the outcome of many years of practical experience.

The process is more especially suitable for the extraction of nickel from ores which contain copper in addition to nickel and iron. These ores, which have on an average between 2 per cent. and 6 per cent. of nickel and about the same amount of copper, are first subjected to "heap roasting," to eliminate the greater part of the sulphur, and to convert the iron which forms their chief constituent into oxide. The roasting is necessary to enable the iron in the following operation of smelting to combine with the silica present in the ore to form a slag, and thus to effect the separation of the iron from the nickel and copper which unite with the remainder of the sulphur to form a regulus or matte. This matte contains the nickel and copper in a more concentrated form, the amount of each metal being usually 15 per cent. to 20 per cent., the residue consisting mainly of sulphur and iron. To concentrate the nickel and copper still further, the matte is "bessemerized." A sample of such "bessemerized" matte is exhibited; it contains 31.37 per cent. of nickel, 48.62 per cent. of copper and 0.70 per cent. of iron. It was prepared by the Canadian Copper Company, Sudbury, Ontario, from their ores, which contain an average of 4 per cent. of nickel and 4 per cent. of copper. This "bessemerized" matte is crushed, ground, and subjected to a calcining operation so as to convert the sulphides into oxides, and it is then passed through a mill and dresser. This calcined bessemer matte then consists practically of nickel oxide and copper oxide in varying quantities. It has been found in the practical working of the process to be advantageous to further concentrate the nickel by extracting part of the copper at this stage by treating the mixtures of oxides with dilute sulphuric acid, which dissolves about two-fifths of the copper present without taking up more than 1 per cent. to 2 per cent. of the nickel. The copper thus dissolved is in the form of copper sulphate and is obtained in a marketable form by crystallization. The undissolved residue from this operation contains between 45 per cent. and 60 per cent. of nickel, and after drying it is subjected to a carefully regulated reducing process by means of water-gas, after which it is treated with carbon-monoxide to extract part of the nickel present. In this first treatment with carbon-monoxide about two-thirds of the nickel can be easily extracted; after this amount is volatilized the extraction becomes much slower, so that it has been found advantageous to recalcine the residues and repeat the copper extraction, the reduction, and the nickel extraction.

The five operations involved are diagrammatically illustrated in Fig. 2. The process begins, as will be seen, at one end with the material to be treated, "bessemerized" matte; it ends with the market product nickel. The "bessemerized" matte proceeds, as the arrow indicates, to the first operation (1) of dead roasting, and for this purpose any suitable furnace may be employed. After roasting, the matte contains 35 per cent. of nickel, 42 per cent. of copper, and about 2 per cent. of iron.[6] It then passes to the second operation (2) for the extraction of part of the copper (about two-thirds) by sulphuric acid, the copper being sold as crystallized sulphate of copper. The residue from this process contains about 51 per cent. of nickel and 21 per cent. of copper, and passes to the third operation (3) for reducing the nickel and incidentally the remaining copper, to the metallic state, care being taken to avoid reducing the iron. This is effected in a tower provided with shelves, over which mechanical rabbles pass, the reducing agent being the hydrogen contained in water-gas. The temperature does not exceed 300° C., and should be kept lower when much iron is present. From this tower the ore is conveyed continuously to the fourth operation (4) of volatilization, in which part of the nickel is taken away by carbon monoxide and forms the compound nickel carbonyl. The formation of this volatile compound is effected in a tower similar to the reducing tower, but the temperature is much lower, and does not exceed 100° C. From the volatilizer, the ore is returned to the reducer (3), and it continues to circulate between stages (3) and (4) for a period varying between 7 days and 15 days, until about 60 per cent. of the nickel has been removed as nickel carbonyl. The residue from this operation, amounting to about one-third of the original calcined matte, and not differing much from it in composition is returned to the first operation and then naturally follows the same course

[5] Ludwig Mond on "Metallic Carbonyls," Proceedings of the Royal Institution, vol. xiii., p. 668.

as before. The nickel carbonyl, produced in the fourth operation, passes to the decomposer (5). This appliance is either a tower or a horizontal retort, which is heated to a temperature of 180° C., so as to decompose the nickel carbonyl and release the nickel in the metallic form, either on thin sheets of iron or, preferably,

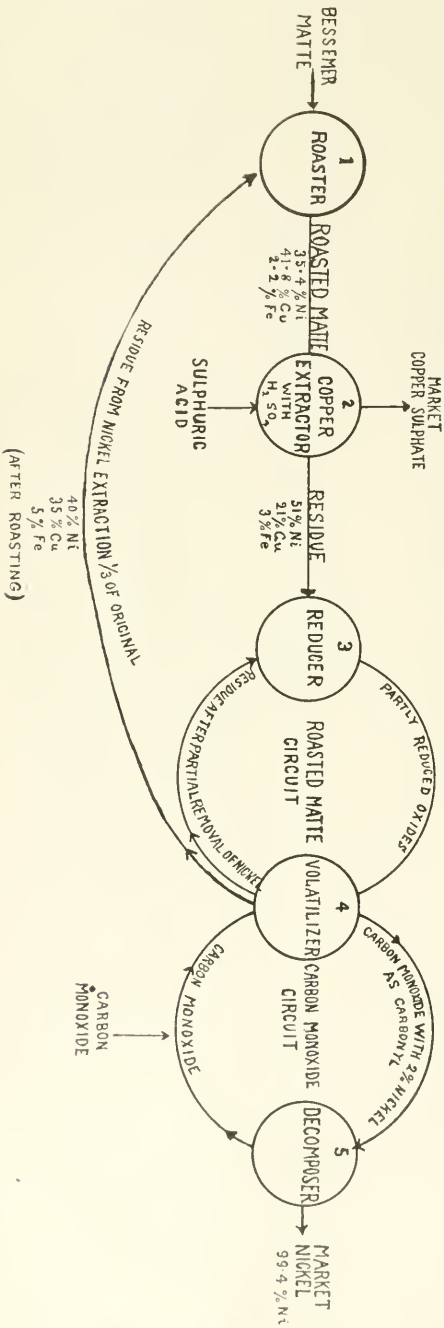


FIG. 2.

granules of ordinary commercial nickel. Carbon monoxide is also released, and is returned to the volatilizer to take up a fresh charge of nickel. It will be evident that, when the operation is in progress, the gaseous carbon monoxide and the partially reduced oxides of nickel and copper are continuously

Average results are given in the Figure, rather than the best which have been obtained.

revolving in two separate circuits which join and cross each other in the volatilizer (4). The commercial product contains between 99.4 per cent. and 99.8 per cent. of nickel.

It will now be possible to proceed to a description of the working as the author saw it in full operation in Smethwick a few months ago. The material under treatment during the author's visit was of Canadian origin, and had been received as calcined bessemer matte containing 35.4 per cent. of nickel, 41.8 per cent. of copper, and about 2 per cent. of iron. This material was first passed through a ball mill and dresser with a sixty-mesh riddle, and was then treated in quantities of 3 cwt. in a small lead-lined mixer with 200 lb. of ordinary sulphuric acid, which had previously been diluted with about 20 cubic feet of mother liquor from previous operations. These appliances are shown in the right hand portion of the plan and elevation, Fig. 1. The temperature of the mixture soon rises by the action between the copper oxide and the sulphuric acid, and is kept, by means of a steam-jet, at a temperature of about 85° C. for ½ hour. From this mixer, the charge is run out into a centrifugal hydro-extractor, provided with a filtering cloth, in which the solution of copper sulphate is separated from the solid residue containing the nickel. After the filtration of the charge is finished, the speed of the hydro-extractor is increased, and the residue is thus rendered sufficiently free from the liquor.

The solution containing the extracted copper runs from the hydro-extractor into a well, from which it is pumped into the crystallizing vats shown in the Figs. After a period of about eight days to ten days, the crystals of copper sulphate are taken out of the vats and the mother liquor is mixed with fresh acid and is again used for the extraction of copper. As already mentioned, a small amount of nickel and a little iron are also dissolved in the sulphuric acid during the copper extraction, so that the mother liquor from which the copper sulphate has crystallized becomes gradually contaminated with these two metals. It is therefore necessary to replace some of the mother liquor from time to time by fresh water, and to recover the nickel from the solution. The simplest method is to evaporate the solution to dryness and to roast the nickel and copper sulphates so obtained. The oxidized material is again introduced into the main process. The copper sulphate crystals from the crystallizing vats are charged into a second hydro-extractor, where they are washed with a little clean water to remove all acidity; they are then dried and are ready for packing. The copper sulphate thus obtained is sufficiently pure for the market, as it contains only 0.05 per cent. of nickel and 0.048 per cent. of iron.

The residue from the copper extraction is taken from the hydro-extractor and stored in a bin until a sufficient quantity has been collected to make up a charge of five to six tons for the nickel-extracting plant. It now contains 52.5 per cent. of nickel, 20.6 per cent. of copper, and 2.6 per cent. of iron. The material is charged by hand at the rate of ½ ton per hour into a feeding-hopper described as the matte inlet in the lower part of the plan, figs. 1, plate 1, which communicates, through a rotary valve, with the conveyor, consisting of a tube enclosing a revolving spiral, which transports the material to an elevator. This lifts the material to the top of the reducing tower, and discharges it through another rotary-valve into this reducing tower.

The reducer and the volatilizer (shown in the centre of Figs. 1), in which the treatment with carbon-monoxide takes place are fully described in Dr. Mond's patent (No. 23,605 of December 10th, 1895). The reducer consists of a vertical tower about 25 feet high, containing a series of shelves, which are hollow so as to admit of their being raised to a temperature of 250° C. by producer gas. The roasted matte falling on these shelves from above is stirred and made to descend from one shelf to that below it by rabbles actuated by a central vertical shaft. Water-gas passes up the tower to effect the reduction of the material. There are about fourteen of these shelves or trays in the tower. The five lower shelves are not heated by producer gas, but are cooled by a stream of water in order to reduce the temperature of the roasted and reduced matte to the temperature at which the volatilizer is worked.

The volatilizing tower resembles the reducer, but the shelves are not hollow, as there is no necessity to heat them. The reduced nickel requires a temperature of only 50° C. to enable it to combine with carbon monoxide and form a volatile compound, and the matte and gas are sufficiently hot to main-

tain this temperature. In the plant at Smethwick the volatilizer was made the same size as the reducer, but in the new plant it is somewhat smaller.

The decomposer has been devised with much care, and has, in its present form, only recently been patented. The nickel is deposited in it, from its gaseous compound with carbon monoxide, on granules of ordinary commercial metal. The arrangements by which this is effected are very ingenious, and may be described almost in the words of Dr. Mond's latest patent. The object is to obtain metallic nickel from nickel carbonyl in the form of pellets, which are specially suitable for the production of nickel alloys. For this purpose gases containing nickel carbonyl are passed through granulated nickel, which is kept at the temperature required for the decomposition of the carbonyl —about 200° C. The nickel which thus separates from the carbonyl becomes deposited on the granulated nickel, which consequently increases in size. In order to prevent cohesion of the granulated nickel, it is kept in motion. When a number of the pellets have attained a convenient size, they are separated by sifting without interrupting the depositing operation, the smaller granules being returned to receive a further deposit from the nickel carbonyl. A convenient form of apparatus for effecting the process described is shown in Figures 3, which represent vertical sections of the apparatus on planes at right angles to each other. A is a cylindrical vessel, preferably built up of short cylinders, *a a*, bolted together; it contains a central tube, C, provided with gas outlet holes, O, through which the gas containing nickel carbonyl, entering at the gas inlet, B, passes into the vessel which is filled with shot, or small granules, of nickel. The gas permeates through the interstices between these granules, and is brought into intimate contact with them, and when the nickel carbonyl is decomposed the nickel is deposited on the granules. The gases finally escape through the outlets, L, into the gas-exit pipe, M. In order to prevent the granules from cohering, they are kept slowly moving by continuously withdrawing some of the granules from the bottom of the cylindrical vessel, A, by means of a right and left-handed worm conveyor, U, which delivers the granules into two sifting-drums, N. The smaller granules fall on to the inclined plane, W, and collect at the base of the elevator, E, which conveys them again to the top of the cylinder, A, and feeds them through the feeding hole, X. In order to avoid the deposition of nickel from the nickel carbonyl in the central tube, C, it is kept cool by causing water to circulate down the tube, F, and up through passages F^1, formed in the central tube, to the water outlet, F^2. The cylindrical vessel, A, is surrounded by a wrought-iron casing, Q, which forms heating spaces, H, communicating with heating-flues, P, which are so arranged that the temperature of each cylinder can be separately regulated by dampers, so as to maintain the temperature of the granules of nickel contained in the vessel, A, at about 200° C., at which temperature the nickel carbonyl is decomposed. With a view to ascertain whether the cylinder, A, is full of granules, a rod, R, is fixed to the spindle of an external handle, which can be turned partly round, so that if the operator feels resistance to the motion of the R, it is certain that the granules extend to that height. The appliance used for depositing the nickel originally consisted of a series of retorts lined with thin steel sheets, on which the nickel was deposited in layers. It was found, however, that the metal so obtained was very difficult to cut, and the apparatus above described was accordingly devised.

A magnified section of a granule of nickel shows that there is a core of nickel which under higher magnification shows a crystalline and convoluted structure, and this core is surrounded by concentric layers. The central core is ordinary commercial nickel, and the layers are nickel deposited from its carbonyl. In some cases granules of deposited nickel are found without any central core. These have grown from minute fragments of deposited nickel which have become detached during the course of deposition.

The water-gas used in the reducer is generated in gas-producers. Anthracite is used to decompose the steam, and the water-gas is collected in a gas-holder, whence it is taken to the reducing tower, to which reference has just been made. This gas contains, on entering the reducer, about 60 per cent. of hydrogen. The reducing operation is so regulated that only a small quantity of hydrogen remains in the escaping gas, as a rule not more than 5 per cent. to 10 per cent. This waste gas is subjected to the action of a fine water-spray, which condenses the steam generated by the combustion of the hydrogen in the water-gas. Part of this waste gas is used for making the carbon-monoxide required in the volatilizer, by passing it through the C O retort charged with incandescent charcoal, which reduces the carbon-dioxide contained in the waste gas, and thus increases the amount of carbon-mononoxide in it. The gas issuing from this retort contains about 80 per cent. of carbon-monoxide, and is stored in another gasholder, which communicates with the main circuit of carbon-monoxide gas. The main circuit of the carbon-monoxide passes through the volatilizer already referred to, where the nickel is taken up. The carbon-monoxide, now charged with nickel, passes through a filter to separate the fine particles of matte-dust from the gases, then through an apparatus called the decomposer, and so described in the Figure. In this decomposer the nickel taken up in the volatilizer is deposited. The gas now deprived of its nickel passes to the C O blower, Figure 1, which sends the carbon-monoxide to the volatilizer in order that it may take up a fresh charge of nickel.

The solid material from which the nickel is being extracted is kept circulating through the reducer and volatilizer for a period varying between seven days and 15 days, during which time the oxides are gradually reduced to the metallic state and the nickel volatilized. When the material originally charged in has had the bulk of its nickel extracted it is run out through a rotary calciner roaster, Fig. 1, which converts the metals into oxides, so that they may be treated for the second time with sulphuric acid and carbon-monoxide. The ratio between the nickel and copper in the residues from the nickel extraction is practically the same as in the calcined Bessemer matte, with which the operations were started, but the amount of iron has increased by the removal of the copper and nickel, as the following figures show: Original matte contains, nickel, 35.27 per cent.; copper, 41.87 per cent.; iron, 2.13 per cent. After the first treatment of copper and nickel extraction, the quantities are, nickel, 35.48 per cent.; copper, 38.63 per cent.; iron, 4.58 per cent., and after the second copper and nickel extraction, nickel, 35.83 per cent.; copper, 35.56 per cent., and iron, 7.82 per cent. The amount of nickel extracted in these two cases was, after the first treatment 61 per cent., and after the second treatment 80 per cent. of the nickel present in the original matte. It must be remembered, however, that in the second treatment only one-third of the original amount remains to be treated, while the final residue is only one-tenth. To avoid the formation of iron carbonyl, the temperature in the reducer has to be kept very low, and if this is done the nickel extracted from a matte originally containing as much as between six per cent. and ten per cent. of iron will not contain more than 0.5 per cent. of iron. If the amount of iron in the residues rises above this percentage, the extraction of the nickel is very much delayed, on account of the low temperature which must be maintained in the reducer. It is necessary, in such a case, to re-smelt the residues before proceeding with the extraction of the nickel and copper. The following are analyses of the deposited nickel:

	I.	II.
	Per cent.	Per cent.
Nickel	99.82	99.43
Iron and (Al O)	0.10	0.43
Sulphur	0.0068	0.0099
Carbon	0.07	0.087
Insoluble residue	....	0.026

The experimental plant at Smethwick has been working for some time, and about 80 tons of nickel have already been extracted in it from different kinds of matte. The results obtained were quite satisfactory, and they point to the conclusion that the process is fully able to compete with any other process at present in use for the production of metallic nickel.

PARSONS' STEAM TURBINE DIRECT-CONNECTED.*

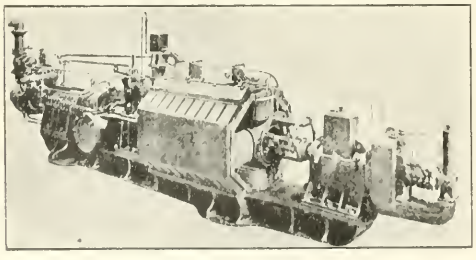
With the steam turbine the conditions are favorable to the larger machines for obtaining the best results and the increase in the sizes manufactured has been rapid, the average at present being about 300 h.p., and we understand that turbo-plants of 4,000 k.w. output are being designed under the Parsons patents for the generation of electrical energy from steam at a very low

*Reprinted from Engineering, London, England.

cost to compete with water power. In the turbine engine, as in the compound triple or quadruple reciprocating engine with which we are more familiar, it is essential for the most economical results, that the capacities of the cylinders should be proportioned to the various stages of the expansion of the steam between the boiler and the condenser. In the ordinary triple-expansion engine this is very incompletely obtained. In the mercantile marine, the ratio of expansion seldom exceeds 16-fold, and in war vessels 9-fold. In the compound turbine any ratio of expansion can be obtained without a material increase in weight or bulk, and in the larger condensing turbine motors, being constructed for driving dynamos, or for marine propulsion, the ratio of effective expansion within the engine is between 100 and 200-fold. It is to this exceptional ratio of expansion, and the economy of the engines themselves, that the satisfactory results which have been obtained in the larger engines are attributed. In the steam turbine the advantages of working expansively are obtained by increasing the length of the blades and diameter of the turbines; and therefore, of course, increasing the area acted on by the steam. In this way, what corresponds in some degree to compounding in a reciprocating engine is obtained, though of course there is not the need to divide the expansion up into stages, as in a reciprocating engine, the expansion being continuous and gradual. So long as the initial pressure is kept constant, the temperature of any one ring of blades will not vary.

The plants, when completed in the machine and erecting shops, are transferred to the testing shop, where they are put under steam, and undergo the usual tests of full and emergency load; the steam consumption being accurately measured. At present the boiler and condenser capacity of the shop is sufficient for prolonged tests up to 500-k.w. output, but this will shortly be increased to 2,000 k.w., when plants up to this size will undergo a full series of tests before being sent out from the works. New large machine-shops, erecting-shops, pattern-shop and offices are at present in course of erection, and will be specially equipped for the production of the larger turbine plants of standard sizes and design for continuous current and single, two, or three-phase alternating current.

We do not propose in these articles entering into the construction of various types of generators made by Messrs. Parsons, as that would take us too far afield, but any description of the works would hardly be complete without some notice of the product. There are thirteen 350 k.w. turbo-alternators now in use for lighting London at the Metropolitan Company's stations at Manchester square and Sardinia street. In the illustration we show a 75-k.w. turbo-generator of another type, four of which have been installed at the Hotel Cecil, London.



Steam Turbine.

The central station of the Newcastle and District Electric Company at Forth Banks, is one of the most important installations undertaken by the Heaton works. A 500 k.w. turbo-alternator has been more recently erected in the same station.

This company obtained powers to supply energy in 1889, and on January 10, 1890, the works were opened with three Parsons turbo-electro generators of 75 k.w. capacity each. The company has been a success in every respect from the first, paying a dividend which has increased every year from 2 per cent. in the first to 8½ per cent. in the last year of working.

The small cost per unit for repairs and renewals—and this figure includes all plant, cables, buildings, etc.—is worth noting; as also is the moderate figure which represents the amount required per unit sold to pay interest on capital at 5 per cent. This is important in view of the results obtained. The works are near the River Tyne, from which water is drawn for condensing purposes. The water pipes are laid in a brick lined tunnel about 100 yards long, and terminate in a condenser chamber sunk to mean tide level. There are two sets of plant, one for surface condensation, dealing with light loads, the other for jet condensation, and capable of condensing 48,000 lbs. of steam per hour. The works are peculiarly formed, being placed on the side of a hill, and the various rooms are as it were terraced out. The place originally formed part of Messrs. R. and W. Hawthorn, Leslie and Co.'s marine engine works, and at present is bounded on one side by that company's locomotive shops. As is well known, Messrs. Hawthorn's marine engine department was, some time back, transferred to St. Peter's, lower down the Tyne, and the electric light company thus were able to find a site well suited for its purpose. Advantage could hardly have been taken of the position, however, had it not been that the Parsons steam turbo-generator occupies so small an amount of space, and also on account of the absence of vibration, no foundation being required for the machinery. With regard to the latter feature, it is of interest to point out that Messrs. Hawthorn's drawing office wall forms a continuation of the engine room retaining wall of the electric lighting station; a fact which, in itself, would prohibit the use of ordinary reciprocating engines. The total area of the engine room is only 400 square yards, and in that space there are at present fixed turbo-generators representing nearly 1,720 k.w., with provision for a total of 3,200 k.w.

The use of the steam turbine for actuating electric generators has hitherto created the chief demand for this motor, but there are some other applications of the steam turbine; amongst these that to fan and pump machinery is of considerable importance. It has been found that a centrifugal pump when somewhat modified, is equally efficient whether it is run at 1,200 revolutions, as it generally is, or at 3,200 revolutions. An ordinary 6-inch pump at 1,200 revolutions will give a lift of about 40 feet, but we learn experiment has shown that the modified pump running at 3,200 revolutions will give a lift of about 200 feet, with proportionately greater output. This equals a discharge of about 1,000 gallons per minute, and gives about 60 water h.p. When this is combined with a 100 h.p. turbine, a very compact arrangement is obtained, suitable for mining purposes. A plant was recently erected at Messrs. Storey Brothers', Lancaster, for 850 gallons per minute, at 160-ft. lift, when run at about 3,200 revolutions per minute, and is reported to have given exceedingly good results. For low lifts, the centrifugal turbine pump is not so suitable, and propeller pumps with screws, somewhat like those of a ship's propeller, are adopted. These are suitable for lifts of from 10 to 40 feet.

Another department of these works is devoted to the manufacture of fans for ventilating purposes, and also for induced and forced draught. For the last three years, a fan 3 feet in diameter has been running at Mr. Cookson's works, Howdon-on-Tyne, drawing hot gases, and exerting a pressure of 7-inch water gauge with 2,000 revolutions per minute. It has practically run day and night since the start. Fans have also been made at the Heaton works for forced draught on board ship, and for land purposes. At the time of our visit one was being erected to give induced draught at 3-inch water gauge to two marine boilers capable of evaporating 25,000 lbs. per hour.

Another application of the fans is for colliery ventilation. Engineering describes a 5-foot fan which has now been running for nearly three years at the Clara Pit, Wylam-on-Tyne, a large colliery in the Tyne district exhausting 120,000 cubic feet per minute at 2¼-inch water gauge; and another fan has just been erected at the Tredegar Coal Company's pit in South Wales for 300,000 cubic feet of air per minute at 3 inch water gauge.

Both fans and pumps are reported to have given good results for economy. One advantage is that practically no foundations are required; in one case the total cost of fan, brickwork and foundations amounted to one-third that needed for an ordinary slow-speed fan. This was largely on account of the small quantity of brickwork and foundations which were necessary. Although we are not entering into many details of construction reference may with advantage be made to the interesting feature of the governing of turbines. It may be effected by an electrical governor, or by a centrifugal governor, as may be found most suitable for the special work. If constant speed is required, as in alternators which have to run in parallel with

others, the centrifugal governor type is adopted; if, however, constant voltage is desired, the electrical governor is used. In the latter the voltage is automatically controlled by the governor, and so accurately can this be done that any desired voltage can be obtained at either full load or no load to within 1 per cent. without altering the governor. Thus, if 5 per cent. rise of voltage is desired at full load in a 100-volt machine, the governor can be adjusted to give 100 volts at no load, and 105 volts at full load. The governor is exceedingly prompt in its action, and large variations of load cause little variation of voltage, thus making the turbine specially suitable for traction purposes.

In both types of governor, one end of a lever is moved up and down either by the centrifugal governor or by a core controlled by a spring, and actuated by a solenoid in shunt with the terminals of the machine. This lever actuates a small valve, which is further moved to a small degree up and down at equal intervals. This small valve, by a steam relay arrangement, actuates the piston, which, in turn, actuates the main admission valve. The result is that at small loads the steam is admitted in a series of equal puffs, thus getting the advantage of the high-pressure steam, and securing great economy at small loads. As the load increases these puffs get longer and longer, until at full load the admission of steam is continuous. The puffs are at such rapid intervals that there is no perceptible variation of the speed of the turbine between each puff. Another advantage of the movement of the valve up and down is that everything is kept in a state of movement, and therefore there is no liability to stick, and all hunting is avoided.

SAND FILTRATION OF PUBLIC WATER SUPPLIES.*

BY R. S. LEA, ASSOC. M. CAN. SOC. C. E.

(Continued from last issue).

The operations which have been described in the foregoing pages are those connected with the carrying on of what is known as continuous sand filtration; and in determining what methods produce the best results, our only test has been the degree of bacterial purification effected. The reason of this is, as we have already seen, that in waters at all likely to be used as public supplies, the actual amount of organic matter is relatively so small as to be of little sanitary significance. Nevertheless, there is a certain degree of chemical purification effected by this process. Analyses of the effluents show a reduction of the dissolved organic matter of from 30 to 60 per cent. This is brought about by the action of the bacteria, which, though existing under adverse conditions, are yet capable of producing this result in the presence of the free oxygen in the water, the amount of which is usually quite sufficient for the purpose. Now, in the case of sewage, which is only very highly polluted water, the amount of free oxygen is very small in comparison with the organic matter present. And it was found, in making experiments on the purification of sewage by passing it through beds of sand, that if air were artificially introduced a very complete reduction of the organic matter would be effected by the bacteria. This was accomplished by working the bed intermittently; that is to say, at regular intervals of time—say 24 hours—the bed was allowed to drain, and fill its pores with the air drawn in after the sewage. After taking this breath the bed rested for a day; then the sewage was again turned on to the surface, preventing the escape of the air which was necessary to provide oxygen for the next 24 hours' purification. The same method used in connection with water is what is termed intermittent filtration. The first filter of the kind was built at Lawrence, Mass., by H. F. Mills, C.E., member of the State Board of Health. Since then, small plants on the same principle have been built at Mt. Vernon, N.Y., and Grand Falls, North Dakota. The results do not seem to indicate any necessity for their use, not being at all superior to those of continuous filters, while the method of operation is not suited to cold climates, and either requires a greater area of bed or a higher rate of filtration. A description of the Lawrence filter may be found in Trans. Am. Soc. C.E., 1893, p. 350.

From what has been said, it will be evident that where the water is at any time liable to turbidity, a settling basin, capable of holding from 12 to 24 hours' supply at least, must be provided. Also, in order that the filter may be able to work continuously at a uniform rate, a clear water basin will be necessary of a capacity sufficient to cover the maximum fluctuations in the consumption. If the supply is from a storage reservoir, the filters are placed below the dam, and are, of course, supplied by gravity. But even when the supply is from a river or lake, the topography of the ground often admits of the same economical arrangement. If this is not possible, the water must be pumped into the settling basin by a separate pump of the low lift variety. The extra expense of two pumpings may be almost eliminated if the same station, boiler plant, etc., can be made to serve for both pumps. The total area of filter beds required depends in the first place upon the maximum rate adopted; and, second, upon the area out of use while being scraped and refilled. The higher the rate of filtration the less the total area, and therefore the first cost of the plant. The principal item of expense connected with the operation of this plant is that for scraping; and it is found that the amount scraped for any given quantity of water filtered is independent of the rate. Also, the allowance for the area out of use will not vary with the rate to any extent. Hence an increase in the rate will not by any means produce a proportionate reduction in the cost of filtration. A rate of 3,000,000 gallons per acre of bed in use will give results entirely satisfactory from the standpoint of efficiency, and at a cost which is usually by no means excessive.

The size of the individual beds will depend in part upon the extent of the total area, the smaller plants having necessarily to use smaller beds. A large bed costs less per unit of area than a small one, on account of the proportionately greater length of wall in the latter case. With a large bed it is, however, probably more difficult to obtain a uniform rate of filtration over the whole area. During the winter of cold climates the cost of maintenance is considerably increased by the expense of removing the ice which forms in the bed. It is also difficult to avoid injuriously disturbing the surface of the sand. Beside this, when the water is drawn down the surface sometimes freezes before it can be scraped. On account of such disadvantages as these filter beds should be covered in all cold climates. The best method of constructing these roofs has already been referred to. The proper number, shape, and area of the beds of a system can only be determined for any particular case by careful study of the local conditions, and by making comparative estimates of the different items of cost of construction, maintenance, etc. There will be opportunities for the exercise of considerable ingenuity in the general laying out of the system, the relative placing of its parts, the arrangement of the piping, drains, etc., in order that convenience and economy may be happily combined.

The cost of construction will of course depend on the local circumstances and the kind of materials used. As in all hydraulic work, great care is required in the construction, and the best quality of materials must be used. In the main, it is the same class of work as is required in the building of distributing reservoirs. The following table gives the cost of construction for several European and American filters:

Place.	Cost per Acre.	
	Covered.	Open.
London		$24,000—$40,000
Berlin (1884-87)	$66,000—$70,000	
Hamburg (1893)		30,500
Warsaw (1885)	78,000	
Zurich (1885)	86,000	
Nantucket, Mass. (1892)		45,500
Hudson, N.Y. (1874-88)		73,000
Ilion (1893)		96,700
Ashland, Wis., (1897)	80,000	
Somersworth, N.H. (1898)	64,000	
Poughkeepsie, N.Y. (1872)		90,000
Poughkeepsie, N.Y. (1896)		41,000

Lindley gives the general cost of continental filters as $45,000 per acre for open, and $68,000 for covered. The following figures, giving in detail the bids received February 15th, 1898, for constructing the water filtration plant now in process of construction at Albany, N.Y., will be of more interest. When completed it will be by far the largest plant yet built in America; and in general design and completeness of equipment it will be second to none. It will consist of a settling basin of 16,000,000 gallons capacity, eight covered filter beds, each with 7-10 of an

*From a paper read before the Canadian Society of Civil Engineers.

acre of sand surface, and a clear water reservoir with a capacity of 100,000 gallons. There will also be provided an office building containing fully equipped chemical and bacteriological laboratories. The price for the sand and gravel included the necessary screening, washing and putting in place. The sand washer is of the ejector type. The bids are as follows:

Material.	Quantities.	Prices of Successful Bidder.	Other Bidders.	Engineer's estimates.
Shale rock excavation	5,000 cubic yards	$ 1.20	$ 0.30 to $ 1.50	$ 0.80
Earth excavation (above grade)	60,000 cubic yards	.27	.13¼ to .476	.20
Earth excavation (below grade)	3,000 cubic yards	.30	.20 to .60	.40
Rolled clay and gravel embankments	21,000 cubic yards	.52	.45 to .90	.50
Silt and loam filling	23,000 cubic yards	.15	.15 to .50	.20
General filling (rolled)	18,000 cubic yards	.18	.07 to .40	.20
Puddle in place	13,000 cubic yards	.71½	.67 to 1.07	1.00
Broken stone or gravel for lining	1,900 cubic yards	.85	.99 to 1.40	1.25
Sodding	3,000 square yards	.15	.15 to .60	.15
Seeding	8 acres	25.00	12.50 to 70.00	50.00
Gravel in roadway rolled	800 cubic yards	.60	1.00 to 1.50	1.00
Vitrified brick laid as paving	120 M	20.00	18.00 to 30.00	20.00
Stone curbing	800 lineal feet	.60	.75 to 1.50	.50
*Concrete in floors	11,000 cubic yards	2.31	2.34 to 3.50	3.00
*Concrete in vaulting	7,000 cubic yards	3.85	3.90 to 7.50	5.00
Other concrete	3,000 cubic yards	2.13	2.50 to 4.30	3.00
*Brick work	4,500 cubic yards	8.12½	7.00 to 10.00	6.00
Imported Portland cement	500 bbls.	3.12½	2.35 to 3.00	2.75
American Portland cement	14,000 bbls.	2.14½	1.90 to 2.21	2.15
Rosendale cement	1,500 bbls.	.97½	.85 to 1.95	1.00
Furnishing and placing 2-inch drain pipe in piers		525.00	300.00 to 1,318.00	700.00
2-inch agricultural drain pipe	2,000 lineal feet	.04	.05 to .10	.05
*6-inch drain pipe, open joints	16,000 lineal feet	.11	.10 to .12½	.10
Furnishing and laying all vitrified pipe cement joints		5,337.00	3,850.00 to 5,933.00	6,000.00
*Placing all gates, etc., furnished by board		1,140.00	700.00 to 2,000.00	470.00
*Furnishing and placing all cast-iron pipe and specials		20,701.25	14,750.00 to 20,000.00	15,000.00
*Iron filter covers	672 each	4.40	5.00 to 6.50	5.00
*Sand washing apparatus	2 sets	393.00	250.00 to 1,000.00	800.00
*Sand run fixtures	8 each	407.50	100.00 to 511.00	200.00
*Regulator houses	8 each	862.24	175.00 to 900.00	500.00
*Office and laboratory building		4,881.00	2,700.00 to 10,200.00	3,000.00
*Filter gravel in place	7,000 cubic yards	1.05	1.00 to 2.00	1.50
*Filter sand in place	36,000 cubic yards	1.00	.90 to 1.78	1.25
Split stone lining	2,000 square yards	.82	1.03 to 3.60	2.00
Rough stone paving	200 square yards	.82	.93 to 2.50	.80
Fasteners furnished and placed in concrete vaulting	3,000	200.00	150.00 to 225.00	100.00
Iron fence	850 lineal feet	2.00	1.00 to 2.00	1.00
Connection with pump-well and closing old intake		3,000.00	1,000.00 to 4,000.00	3,500.00
Total		$300,866.00	$322,358.00 to $387,345.00	$322,440.00

The items of special interest are marked thus *

It will thus be seen that a covered filter plant of this area (5.6 acres) with settling basin, clear water basin, and all other appurtenances complete can be built for less than $50,000 per acre. For further details and information concerning this plant see Engineering News, Feb. 10th and Oct. 20th, 1898.

The total cost of maintenance of a filtration plant is made up of the operating expenses, and the interest and sinking fund charges. The former—the operating expenses—comprise: (a) The cost of superintendence, and of attendants to look after the regulation, etc.; (b) the cost of scraping and removing the sand; (c) the cost of washing the sand; (d) the cost of replacing the washed sand when renewal of the bed becomes necessary.

It is only in very large plants that a special superintendent is required, so that the expense for that purpose would not form a very large part of the total cost. The proper handling of the gates, and the running of the plant in general requires a degree of intelligence considerably above that of the ordinary laborer. The wages of the gatemen therefore will be from $2 to $3 per day. Scraping and removing the sand by wheelbarrows seems to cost, under ordinary circumstances, between $40 and $50 per acre, depending upon the wages paid. At Mount Vernon, N.Y., the shovellers and barrow wheelers are paid $1.10 per day, and the scrapers $1.25. Chas. Fowler, for many years in charge of the filters in Poughkeepsie, N.Y., says that one man working one hour is required for every 150 square foot of surface cleaned and removed. This would cost at $1.50 per day, about $43.50 per acre. Lindley gives 30 days at 10 hours each for every acre, which at the same rate is $45 per acre. In the small plants at Ilion, N.Y., and Ashland, Wisconsin, the cost is at the rate of about $50 per acre. The cost of sand washing varies with the method employed. In Poughkeepsie, when they used a simple inclined trough and water jet, it cost as high as $1.50 per yard. By improving their methods they reduced this cost, till to-day it is only 27 cents per yard. In Hudson, the cost is 20 cents per yard, and in Ilion 18 cents. In Germany it varies from 14 to 20 cents per yard.

The periodical replacing of the sand in the bed must be done carefully of course, but should not cost, including whatever is necessary to be done to the permanent layer, more than 40 cents per cubic yard. The cost of these various operations will of course depend upon the scale on which they are carried on. It will obviously be easier to keep the price low with a large plant than a small one. In the case of the former a force of gatemen and laborers can be permanently employed. In the smaller plants the operations of scraping and sand washing only take place at intervals, and are performed by laborers hired temporarily for the purpose, or by employees from other parts

of the water system. In using the above data to make an estimate of the total operating expenses, we shall employ as a unit the cost per million gallons of water filtered. Assuming an average yield of 50 million gallons per acre between scrapings, the total cost would be as follows:

Scraping and removing at $45 per acre	$0.90 per mill. gals. filt.
Washing 100 cu. yds. sand at 25c. yd.	0.50 per mill. gals. filt.
Replacing, etc., at 40c. yd.	0.80 per mill. gals. filt.
Superintendence, etc	0.25 per mill. gals. filt.
Total	$2.45 per mill. gals. filt.

To this should be added the cost of bacterial analyses of the effluents which should be made as frequently as possible in order to test the working of the filters. In many of the European plants a fully equipped laboratory is included in the equipment; and some of the superintendents, like Piefke, chief engineer of the Berlin works, are also expert bacteriologists. The actual cost of the operations discussed above for some American filters is as follows:

Poughkeepsie, N.Y., for 20 years aver.	$2.90 per mill. gals. filt.
Hudson, N.Y., is given as	1.38 per mill. gals. filt.
Mount Vernon, N.Y., a little less than	2.00 per mill. gals. filt.
Ashland, Wisconsin, estimated to cost	2.25 per mill. gals. filt.

The following table furnished by W. B. Bryan, Esq., chief engineer, East London Water Co., gives the yearly cost of filtration of the London Water Companies from 1890 to 1895:

COST PER MILLION U.S. GALLONS.

Name of Company.	1890-1	1891-2	1892-3	1893-4	1894-5
Chelsea	$ .72	$ .75	$ .62	$1.16	$ .60
East London	1.42	1.54	1.42	2.63	1.69
Grand Junction	1.33	1.24	1.30	2.00	1.68
Lambeth	.86	1.01	1.20	1.46	2.54
New River	1.02	.93	1.17	1.43	1.03
Southwark and Vauxhall	$1.17	$1.15	$1.26	$1.53	$1.34
West Middlesex	1.01	.97	1.42	.95	.96

To get the total cost of maintenance, we must include with the operating expenses the charges for interest and sinking funds. This will of course depend upon the cost of construction; and the latter will vary with the maximum rate of filtration adopted, and the proportion of the total area to be out of use while being cleaned. These being decided upon, it will then be easy to calculate the first cost per million gallons of daily yield. For example, if, with the rate chosen, the daily yield of the plant will be 2,000,000 gallons per acre of the total area of beds, the first cost per million gallons will be half the cost of construction per acre, and so on. The diagram gives the cost per million gallons filtered, corresponding to different construction costs, which will pay the interest and sinking fund charges necessary to cancel the whole first cost with interest at the end of 40 years. For example, with a first cost of $60,000 per acre, and a net yield of 2,000,000 gallons per acre of total area, the cost per million gallons with interest at 4 per cent. would be $4.15. With interest at 4½ per cent., and a first cost of $80,000 per acre, first cost would amount to about $6. Add to this $2.50, for the expense of operation, and we should have $8.50 as the total cost of filtering 1,000,000 gallons of water, or 1,000 gallons for less than 9-10 of a cent.

Having now discussed the method and cost of sand filtration, the next and last question to be considered is the nature of the results which this process can be depended upon to produce. There can be no question as to its efficiency from an aesthetic point of view. The complete removal of even the most minute particles in suspension, together with a large part of the dissolved organic matter, ensures the entire elimination of any characteristics the water may possess which would be disagreeable to sight, taste or smell. Yet it is because of the effectiveness of the purification from a sanitary standpoint that this system is especially noted. This is due to its destructive effect upon the bacteria, which is almost sufficient to cause their disappearance during the passage of the water through the filter. The average reduction in a well designed and well managed plant will be as great as 98 or 99 per cent., as shown by comparing the number of germs in the effluent with that in the applied water. But in reality it is even greater than this. For it has been shown that of the few bacteria which are present in the effluent, a certain number come from the underdrains, and have therefore not passed through the filter at all. These belong to some of the species of water bacteria, and, consequently, will be quite harmless. From tests made on the experimental filters at Lawrence with an easily recognized and hardy species, the actual reduction was found to be from 99.9 to 100 per cent. Now, when it is considered the filter is capable of producing such effects upon bacteria which exist normally in water, it will be evident that the effect upon the pathogenic or disease germs which are out of their natural habitat and in a decidedly unfavorable environment will be much greater. Thus what may be called the "hygienic efficiency" of this system must be remarkably high. The process is comparable to nature's method of purifying the surface water which furnishes the underground supplies; and if properly carried out, the water produced is probably of almost equal wholesomeness. The continued experience of places where sand filtration plants have been in operation for some time only goes to strengthen this conclusion.

In America the method is only just beginning to be employed. Up to the year 1892 there were but two plants of this description in the country, viz., those at Hudson and Poughkeepsie, which have been already referred to. Since that time 14 new ones have been completed, and three others are under construction, the latter including the large plant at Albany. The experience to be derived from these plants is too limited to be of much value for some time to come; but the officials connected with the majority of them have invariably expressed their entire satisfaction with the method of working and with the results obtained.

(To be continued).

Industrial Notes.

The Calgary Milling Co. will build an elevator.

At Truro, N.S., T. G. McMullen is completing a pulp mill.

Goderich, Ont., has voted a bonus of $10,000 to the Kensington Furniture Co.

Windsor, Ont., is buying a site for a drill shed to be built there by the Dominion Government.

The contract for the new public works office at Regina, Assa., has been let to Willoughby & Mallard.

G. H. Hopkins and J. D. Flavelle have bought the Lindsay, Ont., waterworks. F. K. Begbie will be manager.

The ratepayers of Woodstock, N.B., will vote on a bylaw to give a $50,000 bonus to a pulp mill on October 16th.

Kamloops, B.C., has voted $27,000 to improve the waterworks, and $15,000 to extend the electric light plant.

An addition will be erected to the John H. Stratford Hospital, Brantford. An isolation hospital may also be built.

The overhead bridge across the M.C.R. near Kingsmill, Ont., which was recently burned, is being replaced by a new one.

H. M. Whitney, Boston, president of the Dominion Iron and Steel Co., has given $25,000 to build an hospital in Sydney, Cape Breton.

The Canadian Rubber Co., Montreal, has ordered a 100 h.p. Mumford Improved boiler from the Robb Engineering Co., Amherst, N.S.

Joseph Black, Toronto, has been continued as editor of The Iron Moulders' Journal by the Iron Moulders' Association of North America.

The boiler inspectors in Montreal are enforcing the city bylaws requiring the use of smoke consumers, and heavy fines are being imposed.

The L.E. & D.R.R. is pulling down its grain elevator at Port Stanley, Ont., which was built four years ago, and removing it to Sarnia.

Smith's Falls, Ont., has appropriated $150,000 to put in a system of water supply and sewage. Willis Chipman, C.E., has prepared the plans.

Graham Moon, of the Postoffice Department, Ottawa, is said to have invented a roller boat, which it is claimed is better than Knapp's failure.

The Kingston School of Mines is trying to secure $6,000 to equip a new laboratory. The expenses last year were $2,070 in excess of the receipts

The contractors have commenced work on the Hoepfner Refining Co.'s nickel works at Hamilton.

John Dittrick's bolt and nut factory at Perth, Ont., is nearly completed and will soon be in working order.

The annual convention of the International Building Inspectors' Association took place a month ago in Quebec.

Brantford, Ont., will build a new Isolation Hospital, and make a large addition to the John H. Stratford Hospital.

The scale manufacturers of the United States are, it is said, to form a trust which will combine most of the leading makers.

W. J. Hamilton, Peterborough, Ont., has invented an improvement in gasoline engines, which is attracting some attention.

Robt. Cameron, contractor, Almonte, Ont., has a contract for building a new wing to Rideau Hall, the official residence of the Governor-General, Ottawa.

The Lillie foundry, Perth, Ont., has passed into the hands of a new firm, The James Bros. Foundry Co., which will operate it on a large scale, it is said.

A bylaw granting W. W. Ogilvie, of Montreal, exemption and free site for his flour mill and elevator at Fort William, Ont., was carried Sept. 11th.

J. E. Asquith and others of Ottawa, Ont., propose to put in waterworks and sewage in Arnprior, Ont. They would also take over the electric light plant.

The Mattawan Iron Co. is in correspondence with the town of Fort William over the $50,000 bonus for a smelter, which that town has been offering for some time.

A steam plough has been successfully tested at Morris, Man. It will plough 18 acres per day with ease, according to the testimony of the mechanic who made the test.

The contract for raising the piers of the Edmonton, N.W.T., bridge has been let to the Dominion Bridge Co. It has been decided to add eight feet to the present height.

The acetylene gas apparatus in T. Ivory & Co.'s store, Omemee, Ont., exploded, September 26th. The generator was wrecked, but no considerable damage was done the building or contents.

The William Kennedy & Sons, Ltd., Owen Sound, is building an extension to its foundry. The addition, which will be used for the manufacture of steel castings, will give employment to between twenty-five and thirty men.

The following were elected officers at the convention of the United Brotherhood of Railway Trackmen in Ottawa: President, J. Logan, Ottawa East; vice-president, J. Hogan, Ottawa; secretary, H. McKenny, Ottawa; treasurer, A. Thompson, Ottawa.

St. Henri, Que., council has granted a tax exemption to the Merchants' Cotton Company to erect a factory in the municipality. The following proviso was made: "The company will have to agree to employ three hundred persons, to whom a yearly sum of $50,000 will have to be paid as salary."

The Nova Scotia Steel Company is making preparations for building another smelting furnace. The large steel building will be extended some eighty feet to cover the new furnace, and bring the steel travelling crane in connection with it. The furnace will produce 100 tons of steel a day.

The large iron works of Carrier, Laine & Co., Levis, Que., are crowded with orders. The establishment employs about 425 hands, and all are busy. Within the last three months a general increase in the wages has taken place, and the men are now receiving about fifteen per cent. more than formerly.

McLachlin Bros., Arnprior, lumbermen and sawmill owners, chartered two C.P.R. trains and gave a free trip to the Ottawa Exhibition to their employees, and paid not only the fare of the excursionists, but their entrance fee to the Exhibition. Thirteen hundred men, women and children were thus entertained.

A. S. Chrystal is giving up his business as steam boiler manufacturer here, and will remove to London, to enter the London Engine Supplies Co. The company will manufacture steam boilers and steam heating appliances, will sell engines, boilers, etc., and will conduct a repair shop for engines and other machinery.—Goderich Signal.

The Simcoe Peat Fuel Company, Barrie, Ont., commenced operations a short time ago, and this industry promises to give employment to a large number of men.

Frank White, representing the Canadian Peat Fuel Co., Toronto, has gone to Tullamore, Ireland, where he is going to install a plant for the Canadian Peat Fuel Co.

H. E. Hill, of Halifax, N.S., has ordered a 100 h.p. steam plant from the Robb Engineering Company, Ltd., Amherst, N.S., for the new works of the Maritime Explosives Company.

The Good Roads Machinery Co., of Hamilton, has taken action against the Sawyer-Massey Co., of the same city, to restrain it from using the phrase, "good roads" in connection with its business.

Notice is given of application for the incorporating of the Aroostook Power Company to erect mills and plant for the manufacture of lumber, pulp and paper at Aroostook Falls in Victoria county, New Brunswick.

J. W. Wilson, Ottawa, has bought two marine type 3 h.p. gasoline engines from the McLachlan Electric and Gasoline Motor Co., Toronto. One of these Mr. McLachlan states is for export to the United States, having been bought for a summer visitor by Mr. Wilson.

The W. R. Brock Quarry Co., Toronto, has bought the Mount Johnson Granite Quarry Works from J. M. Hazel & Co., and has also purchased the Stanstead, Que., granite quarries, including the rights and plant of the Morr Granite Co., with three miles of railway track.

As mentioned last month the business of Tingley & Stewart Mnfg. Co., makers of rubber stamps, etc., Toronto, has been bought by Bernard Cairns, whose familiarity with every detail of the business and exact knowledge and careful methods of carrying it on ensure all patrons that their work will be turned out promptly and as ordered.

The Georgian Bay Portland Cement Company, Ltd., is a new industry established this year in Owen Sound, Ont. Buildings are now practically completed, and manufacturing operations commenced. Seventy-five men will be given employment, and the wages will amount to between $2,500 and $3,000 a month. The output will be 400 barrels per day, and it is expected this will be doubled in the next two years.

The British Government, after careful tests of every known material used for boiler covering, has selected mica covering for Her Majesty's new yacht. After looking into the qualities of mica as a pipe and boiler covering a number of English capitalists have formed a strong company to manufacture boiler covering under the patents of the Mica Boiler Covering Co., of Toronto.

R. H. A. Hunter, W. Hunter, A. Malcolm, G. M. Mackendrick, J. L. Murray, D.D., W. C. Loscombe, J. Boyer, DeW. H. Martyn, M.D., J. Ruettel, G. Wood and J. B. Watson, Kincardine, Ont., and J. Warren, C.E., Walkerton, Ont., have been incorporated as the Hunter Bridge and Boiler Company of Kincardine, Ltd.; capital, $25,000; to carry on the business of Hunter Bros., Kincardine, Ont.

P. Lyall & Sons, Montreal, have installed a large diamond saw, electrically driven, in their stone cutting yard. This saw is a part of the $20,000 electric plant recently purchased by the firm, and includes a travelling derrick and two planers, one of the largest capacity yet made, and the second of smaller size. There are but four of the derricks in use in the stone yards of the United States, and no other in Canada.

E. Leonard & Son made a very fine display of their engines, etc., at the Exhibition recently held in St. John, N.B. Among those who have bought their engines recently from this firm are, W. H. Fowler, of the West End, a 250 h.p. engine to be used in his flour mill. J. W. & W. A. Hutchinson, of Berwick, N.S., have bought the large engine exhibited in the booth. The Acadia Electric Co., of Wolfville, N.S., have sent in an order for one of this firm's 120 h.p. peerless self-oiling engines. J. R. Caulder & Son, of Pepperville, N.S., have ordered a 60 h.p. outfit; E. H. Pickett, of Bridgetown, N.S., a 35 h.p. engine; M. Graves, of Annapolis, N.S., a high-speed engine, and Charles H. Brown, who is starting in operation his new flour mill at Gagetown, has ordered a steam outfit.

A. O. Norton, manufacturer of ball bearing jacks at Coaticooke, Que., has just shipped a large order to Denmark. Several other important orders for export to India, Australia and South Africa have just been received.

Hon. George G. King, Chipman, B.C.; Hon. Ambrose D. Richard, Dorchester; Henry C. Read, Sackville; M. Lodge, Moncton; E. Hutchinson, Douglastown; W. Kitchen, Fredericton, and W. Frank Taylor, Hillsboro, are to be the provisional directors of the New Brunswick Petroleum Co., Ltd., for which a charter has now been applied for. The company will bore for oil; its chief place of business is to be Moncton, N.B., and its capital $1,000,000.

The Owen Sound, Ont., Iron Works Company, Ltd., have revived the business of the old Corbett foundry firm, which closed up during the hard times of a few years ago. They commenced operations last January, and give employment to twenty-five men. The company contemplates enlarging its foundry, increasing its staff and going extensively into the manufacture of propeller wheels, according to a recent report in The Toronto Globe.

The following tenders for the construction of the new drainage system for Lachine, Que., were received: Albert Dini, $209,129.74; Rheaume & Dansereau, $144,816.90; Leopold Leger, $163,230; Chartier & Rebin, $174,095; Martineau, Son & Lemoine, $185,000; Bastien, Valiquette & Parker, $152,523.15; O. L. Hainault & Co., $149,552; Amyot, Lemay & Gauthier, $141,518.88. The contract was awarded to Bastien, Valiquette & Parker, whose tender, though not the lowest, was deemed to offer the best guarantees for the satisfactory execution of this important public work.

Harding & Leathorn, London, Ont., have the contract for building the waterworks at St. Mary's, the figures being $10,081. The specifications call for: All labor in laying the cast-iron pipe distribution system, comprising 1,000 feet of 10-inch pipe; 4,000 feet of 8-inch pipe; 10,600 feet of 6-inch, and 8,000 feet of 4-inch; setting 52 fire hydrants; setting 34 valves; furnishing material for and building 17 valve chambers and setting 17 valve boxes. The contractor also furnishes all materials required except the cast-iron pipes, the pipe specials, the fire hydrants and the valves.

The Canadian Hardware Association at its annual convention in Hamilton, Ont., last month, elected these officers for the ensuing year: President, T. H. Newman of Caverhill, Learmont & Co., Montreal; vice-president, Peleg Howland of Howland, Sons & Co., Toronto; secretary-treasurer, R. and T. Jenkins, Toronto; Executive Committee, Thomas Lee of Rice Lewis & Son, Toronto; R. Angers of Frothingham & Workman, Montreal; E. Jeanotte of L. H. Herbert & Co., Montreal; William Vallance of Wood, Vallance & Co., Hamilton, Ont.; John Bowman of Bowman Hardware Co., London, Ont.

For purposes of record and identification, the Detroit Lubricator Co., Detroit, Mich., has numbered its sight feed lubricators consecutively from No. 1 upwards, so that the number appearing on any lubricator shows how many had been manufactured up to its time. On Sept. 15, 1899, there was completed lubricator No. 400,000. When it is considered that as a rule only one lubricator is used on an engine this figure gives eloquent testimony to the very general use of the Detroit lubricators. The present output of sight feed lubricators alone, of this company, amounts to over 5,500 per month. The Detroit Lubricator Co. also reports a rapidly growing trade in its new style glass oilers and oil pumps.

The F. D. Cummer & Son Co., Cleveland, Ohio, the manufacturer of the well-known Cummer Mechanical Dryers, reports the following sales and shipments for the past two months: Laflin & Rand Powder Co., Pleasant Prairie, Wis., one special dryer to dry 1½ tons of nitrate of soda per hour; United States Navy, Indian Head, Md., one special dryer to dry 1 ton of nitrate of soda per hour; Trent Valley Peat Fuel Co., Peterborough, Ont., one No. 00 "Salamander" dryer to evaporate 2½ tons of water per hour from peat fuel; Warren-Burnham Portland Cement Co., Craigsville, Va., one No. 8 style "F." dryer to dry 2½ tons of slack coal per hour; Peerless Portland Cement Co., Union City, Mich., one No. 00 "Salamander" dryer, to evaporate 2 tons of water per hour, from marl; John McGillen, Chicago, one Cummer portable railroad asphalt paving plant, guaranteed to lay 2,000 yards of 2-inch topping per day of ten hours; Societe Anonyme de Ciments de Vise, Brussels, Belgium, one No. 000 size "Salamander" dryer to dry 15 tons of chalk per hour, and one No. 2 size "Salamander" dryer to dry four tons of clay per hour; T. Herbert Wymonds, Vancouver, B.C., one No. 00 style "F" dryer, to dry 50 tons of fish scrap per day; Pennsylvania Salt Mnfg. Co., Natrona, Pa., one 3 tunnel, 6 track tunnel system complete, for drying iron ore briquettes; Vulcanite Portland Cement Co., Phillipsburg, N.J., one No. 0 style "F." dryer for drying 75 tons of slack coal per day; Wm. Krause & Sons Cement Co., Martins Creek, Pa., one No. 8, style "F." dryer for drying 2½ tons of coal per hour; Premier Tripolite Co., North Sydney, N.S., one special dryer for drying tripoli.

Electric Flashes.

The Montague, P.E.I., Electric Light Co., is making preparations for lighting the village.

Nelson, B.C., is installing additional power for its lighting service, and will shortly be able to supply 4,500 16-c.p. lamps.

The village of Weston, Ont., intends to buy the water-power on the River Humber, and run its proposed electric light plant.

It has been stated recently that the street railway, gas and electric light and power companies in Brantford, Ont., were to be combined.

At the annual meeting of the Quebec Electric Railway, Light and Power Company, A. Thomson was elected president in place of H. J. Beemer.

A project for the construction of an electric railway from St. Catharines to Wellandport, Ont., traversing Fonthill and Pelham, is under consideration.

W. W. Brown, in charge of the lighting plant at Petrolia, Ont., since its establishment, has gone to Camp McKinney, B.C., to take charge of the plant of the Minnehaha Mining Co.

The transfer of the Hamilton and Dundas Railway to the Cataract Power Company was completed Sept. 17th. The company paid $110,000 cash besides assuming bonds amounting to $90,000.

Application is to be made for a charter for an electric or steam railway from Ottawa to Brockville, Ont., with power to operate a ferry on the St. Lawrence, between Brockville and Morristown, N.Y.

The Brantford Electric and Operating Co., Brantford, Ont., is rapidly increasing its power business. The Keys Somerville Printing Co. has installed a 3 h.p., two-phase S.K.C. induction motor with which to operate its new printing presses.

E. H. Caughell, Mary L. Caughell, A. E. Marlatt, Emma L. Marlatt and W. T. Williams, St. Thomas, Ont., have been incorporated as the Port Stanley Electric Railway Co., to build an electric railway from St. Thomas to Port Stanley; capital, $40,000.

Liverpool, N.S., has taken up the municipal electric lighting business, and placed an order with the Royal Electric Co. for a 75 k.w. two-phase S.K.C. generator, as well as the full complement of transformers, and other apparatus. The plant is to be in operation by November 1st.

The Royal Electric Co., Montreal, was awarded the contract for installing the new electric light plant to be added to the plant of the corporation of Picton, Ont. The new plant is to consist of one 120 k.w. S.K.C. two-phase generator, with the full complement of transformers, lamps, etc.

An electric railway between Port Stanley, St. Thomas and London, Ont., the track to be laid along the gravel road connecting those places, is now talked of. A company has been incorporated to build the road, which if successful is to be followed, it is said, by an electric road to Aylmer, Ont.

The corporation of the city of Winnipeg through its Water and Light Commissioners has awarded the contract for the incandescent electric lighting plant to the Royal Electric Co., Montreal. The plant is to consist of a 60 k.w., S.K.C. two-phase alternating generator, with the necessary transformers, etc. The order for the arc apparatus was placed with the Western Electric Co., Chicago, Ill.

The capital of the Citizens' Telephone and Electric Co., Ltd., Rat Portage, Ont., is to be increased from $40,000 to $90,000.

The Mineral Springs Furniture Co., of Preston, Ont., has installed a dynamo and electric lighting plant in its factory.

J. H. Jones has completed the plans and specifications for the Sarnia, Ont., Street Railway Company's proposed new electric line.

The St. Hyacinthe Electric Railway Co. is applying for a Quebec charter to build an electric railway in the counties of St. Hyacinthe and Bagot.

The Hamilton Electric Light and Cataract Power Co. has had certain changes made in its charter enabling it to take over the management of companies of whose stock it has acquired at least two-thirds.

The Robb Engineering Co., Amherst, N.S., is supplying the town of Neepawa, Manitoba, with the steam plant for its new electric lighting system; a 100 h.p. compound engine and two 75 h.p. Mumford improved boilers.

The Royal Electric Co., Montreal, announced a cut of 30 per cent. in electric light rates on Sept. 15th, and the Lachine Rapids Land and Hydraulic Co. has followed with a reduction of 40 per cent., taking effect October 1st.

W. H. Pearson, W. H. Pearson, jr., W. E. H. Massey, J. W. Flavelle, Toronto, and R. Weddell, Trenton, Ont., have been incorporated as the Trenton Electric and Water Co., Ltd.; capital, $400,000; head office, Toronto.

The Ottawa Electric Railway Company has let a contract to Heney & Smith, of Ottawa, for the construction of an electric radial line from Ottawa to Britannia, on Lake Dechene, seven miles. The road is to be completed by November 1st.

J. Playfair, Geo. Chew, D. L. White, jr., and P. Potvin, Midland, Ont., W. J. Sheppard, W. H. F. Russell, W. J. Lover ing, of the township of Tay, county of Simcoe, Ont.; J. J. Drummond, Radnor Forges, Que., have been incorporated as the Midland Power Co.; capital, $90,000; to supply heat, light and power.

At a meeting of the shareholders of the Royal Electric Company, R. Forget, president, in the chair, the bylaw giving power to increase the capital stock of the company by $750,000 was submitted and approved. The stock, it was decided, would be issued on a basis of one to two, so that present holders of two shares would be entitled to one in the new stock.

Hon. S. W. Parent has announced that the English and United States company, which has applied for certain water powers on the upper waters of the Saguenay River, Que., for the purpose of establishing calcium carbide works, will spend over a million dollars there if they obtain the privileges. His engineer is engaged in preparing a report for him on the matter.

The Canadian Niagara Power Company, which obtained a new franchise from the Ontario Government under which, according to the statement of Wallace Nesbit, the company's counsel, it is expected that power will be available for transmission to Toronto, has given a contract for boring test holes along the line of the tunnel it contemplates building on the Canadian side of the Niagara River.

H. Alabaster, Gatehouse & Co., 4 Ludgate Hill, London, E. C., proprietors also of The Electrical Review, announce that the 1900 edition of the Universal Electrical Directory is in course of preparation for its 19th annual issue in January next. This book is of great value, and those wishing to secure the insertion of their names in the forthcoming edition should not lose any time in communicating with the publishers.

In connection with the destruction of water mains by electrolysis the Engineering News, New York, recently recommends the use of wood in joining water mains instead of lead. In St. John, N.B., it has been the practice for nearly half a century to close the joints in city water pipes, not with melted lead, as in most other places, but with pine plugs. The experiment was tried in 1851, and again in 1857. On both occasions it worked so well that the same policy was pursued two years ago. The object in view was economy.

The proposed bylaw to raise $25,000 to establish a municipal electric light plant in Almonte, Ont., was defeated, Sept. 26th, by 38 votes.

The first meeting of the new directors of the Radial Electric Railway since the Cataract Power Company syndicate secured control of the road, was held Sept. 9th, and officers were elected as follows: President, John Patterson; vice-president, Hon. J. M. Gibson; treasurer, John Moodie; secretary, S. E. Malloch.

The Nova Scotia Electric Co. has been organized to supply electricity for lighting and power purposes for the whole of the Annapolis Valley, Nova Scotia. The following officers have been elected: President, Hon. F. W. Borden; secretary-treasurer, J. W. Beckwith, who with Captain H. H. Norwood, C. O. Foss, F. W. Clark, F. B. Wade and Allen Healy will constitute the board of directors.

The St. Catharines Cold Storage and Forwarding Co., Ltd., is replacing its direct current power service now in use in the warehouse, with a 15 h.p. two-phase S.K.C. induction motor. The current for this machine is supplied by the St. Catharines Electric Light & Power Co., which has recently installed in its power house a 200 k.w. two-phase S.K.C. generator for both lighting and power purposes.

At a meeting of the creditors of the Kay Electric Company, Hamilton, Ont., it was decided to wind up the estate, and Mr. Weyler, of the Packard Electric Co., St. Catharines, E. Brown and James Dickson, Hamilton, were appointed inspectors. The nominal assets are $2,312.24, made up of stock and book debts, and the liabilities $1,721.03, of which $637 are preferred claims. The unsecured creditors, it is believed, will get a very small dividend.

Brewder & McNaughton, contractors, have issued a writ in the High Court of Justice against the Metropolitan Electric Co., Ottawa, claiming $50,000 damages for alleged breach of contract and for wrongful deprivation of plant, materials and other goods and chattels. The writ is also for an injunction restraining the company from further use of the said plant. This is the outcome of the dispute which has been going on between the contractors and company which ended in the company taking away the contract from Brewder & McNaughton.

Guglielmo Marconi, the exponent of wireless telegraphy, who is now in New York, said to an interviewer: "The outlook for wireless telegraphy is bright, and the system is constantly being perfected. Messages have been flashed eighty miles, but I do not care to say what has been the greatest distance reached. The experiments have proved that the curvature of the earth is overcome, for in sending the message between stations 80 miles apart the earth curvature, which is over 1,000 feet, has been overcome. The station from which the message was sent was 70 feet high."

A syndicate has bought the Chats Falls at Fitz Roy Harbor, on the Ottawa River, on behalf of the Pontiac Mining Company. The falls are about 35 miles from Ottawa, and a minimum of 141,000 h.p. can be developed at low water and 600,000 h.p. at high water. The purchase was carried through by T. C. Bate, N. A. Belcourt, M.P., W. J. Poupore, M.P., P. Clark, Ottawa; Denis Ryan, St. Paul, Minn., and T. A. Darby, of North Carolina. These gentlemen bought the property as individuals, and are turning it over to the company. The falls, as mentioned some months ago in The Canadian Engineer, are in the middle of a highly mineralized country, and near two lines of railways.

At the annual general meeting of the shareholders of the Great Northwestern Telegraph Company the old board of directors and officers were re elected, viz.: President, H. P. Dwight, Toronto; vice-president, Adam Brown, Hamilton; directors, H. N. Baird, James Hedley, A. S. Irving, W. C. Matthews, Toronto; Richard Fuller, Hamilton; Hon. William McDougall, Ottawa; and Charles A. Tinker, New York; secretary and auditor, George D. Perry; treasurer, Arthur Cox. The financial statements presented showed a marked improvement in the revenue of the company over the previous year, and it was stated that the outlook for the coming year was still more hopeful.

Marine News.

Smith Bros., Quoddy, N.S., are building a steam boat 68 feet long for Wm. Butler, Yarmouth, N.S., to be completed November 1st.

Sheet piling is to be driven on both sides of the Burlington Beach canal, Hamilton, Ont., to such a depth that it may be dredged to a depth of 20 feet.

Isaac Radford, Buffalo, is arranging with J. Gaskin, Kingston, Ont., for boats from the latter for transferring a large quantity of iron ore from Three Rivers, Que., to Buffalo.

The Quebec, Hamilton & Fort William Navigation Co., which was incorporated a short time ago, has sent A. B. McKay to Great Britain to buy two 3,000-ton steel freight steamers for the lake trade.

The Richelieu & Ontario Navigation Co. will make a very interesting exhibit at the coming Paris Exhibition. Photographs of the fleet and the various hotels of the company, together with views of the scenery of the route will form part of the exhibit.

The record from Liverpool to Quebec was made by the "Canada" of the Dominion Line, which sailed from Liverpool 5 p.m., Thursday, October 29th, 1896, arrived Quebec 11.20 a.m., Thursday, November 5th. This still remains by almost 20 hours the fastest trip of any steamer to St. Lawrence ports.

The steamer "Delta," employed in carrying coal between Louisburg, C.B., and St. John's, Nfld., was reported wrecked at St. Mary's Bay, Nfld., Sept. 14th. She formerly belonged to the Cunard Steamship Company, and was 550 tons register. She was the second steamer to cross the Atlantic between England and Halifax.

The returns of the traffic through the Sault Ste. Marie canal from the opening of navigation on April 26th until Sept. 24th, show a considerable falling off. For the present year the number of vessels which have passed through the locks is 2,725, with a tonnage of 2,092,701, and a freight tonnage of 2,114,984. For the corresponding period of last year the number of vessels was 3,048, tonnage 2,211,899, and a freight tonnage of 2,463,058.

A new tug, "Robert Mackay," has been built for the Harbor Commissioners, of Montreal, by Carrier, Laine & Co., Point Levis, Que. The new vessel is a powerful looking craft, and has a speed of over eleven miles an hour. Her dimensions are as follows: Length between perpendiculars, 71 feet; length over all, 81 feet 9 inches; breadth, moulded, 17 feet 6 inches; depth, moulded, amidships, 11 feet 5 inches; draught forward 8 feet, draft aft 9 feet 6 inches. The tug is built of steel. The cost was about $8,000.

"Success has attended every service this season," said C. S. Gildersleeve, manager of the Richelieu & Ontario Navigation Company, in a recent interview published in a contemporary, "and the earnings are over $100,000 net, in excess of those of last year." He stated further that so encouraged was the company that other new steamers would be added to the western service, and to that between Quebec and Montreal. At present the boat-builders were congested, and it would take a year to get one new boat ready. During the coming winter the steamer 'Longueuil,' would be rebuilt, and the ferry service perfected as far as possible. The new steamer 'Toronto' had helped to swell the earnings, and only proved that the public appreciated first-class accommodation. The hotel department of the company promised to expand, as it, too, had proved highly successful. The new hotel at Murray Bay was 'under way,' and would, he expected, be ready by June 15, 1900."

Objection has been made by United States vesselmen to paying fees for the inspection of United States vessels running to Canadian ports, though the Canadian officials have been carrying out the law of Canada, whereby Canadian vessels were charged inspection fees. American vessels were treated in exactly the same way. For the past ten or more years the American Government has been in the habit of inspecting Canadian vessels running to American ports. The Canadian Government has repeatedly requested the American Government to accept the Canadian inspection in American waters in lieu of the United States inspection being accepted in Canadian waters, but this reciprocity had not met with favor. The margin of safety under the Canadian law is said to be much greater than that under the United States law. In the first place the steam boilers of Canadian vessels are not allowed to use within 25 per cent. so high a steam pressure as is permitted under the American inspection.

Mining Matters.

Geo. McIlraith's iron pyrites mine in Darling township, Lanark county, Ont., is now being worked.

Work at the Ostram nickel mine on the Calumet Island, Que., has been resumed by the English-Canadian Mining Co.

Gold has been found on the farm of Robert Grier, 4th line, Ramsay, Lanark county, Ont. An assay is said to show gold amounting to $8 per ton.

The mica mine discovered on the property of Robert Schnider, 7th concession, Sydenham township, Frontenac county, Ont., has been bought by G. Moriel, Kingston, Ont., who will work it.

The richest mica mine so far discovered in the Gatineau district, that of Father Guay at Gracefield, Que., has been sold to W. H. Sills, Chicago. A complete equipment of the newest machinery will be installed.

The Sailor mine, Camp McKinney, B.C., is sinking a vertical shaft by contract for 100 feet, and when that depth is reached a hoisting plant, which was recently ordered in this city from the Jenckes Machine Company, will be installed.

The first discovery of coal in the Boundary district of British Columbia, it is claimed, has been made by Robert Clark. The seam is said to average 25 feet in width, and is on the north fork of Kettle river. Jay P. Graves has bought a half interest, and will develop the property at once.

On the Minnehaha mine, Camp McKinney, B.C., a five-drill Ingersoll Sergeant compressor and an 80-h.p. boiler have just been installed. The plant is to be used to extract ore in sufficient quantities to run a 10-stamp mill which the company has ordered. There is considerable high grade ore in sight in the mine.

The Dunnville, Ont., Natural Gas Co. has been incorporated with a capital of $20,000. The provisional directors of the company to be J. Taylor, F. J. Ramsey, W. W. Krick, J. Norris, W. Shirton, W. D. Swayze, J. Parry, C. Shirton, T. Rice, L. Massecar, W. Bullock, J. E. Griffin and R. Bradford, of Dunnville, Ont.

J. Johnston, manager of the Crow's Nest Coal Co., Fernie, B.C., stated recently that 500 men were now engaged in the company's mines, that the mines were lighted by electricity, and the coal was hauled to the pit's head by electric motors. The company can produce 1,000 tons of coal every 24 hours, and when the coke ovens now being constructed are completed it will supply 300 tons per day.

Telephone connections have been made from Mine Centre Ont., to all the mines of the Bad Vermilion Lake group, including the Golden Star, Decca, Manhattan, Olive, Lucky Coon, Aria, Alice A., and many others. The Manhattan Gold Mining Company is installing a compressor plant, and fifteen additional stamps are being installed at the Olive mine.

The Iron Mask Gold Mining Co., Rossland, B.C., is enlarging its electric hoist and air compressor, and has placed an order with the Royal Electric Co. for a 120 k.w. S.K.C. synchronous motor. The first order received by the above company from the Iron Mask was for a 75 k.w. S.K.C. motor. This was found not large enough for the requirements.

W. R. Arnold of the Valley Worsted Mills, Providence, R.I., and David Sherwood, Rhode Island, were recently in St. John, N.B. They are interested in the Intercolonial Copper Mining Co., whose property is situated near Dorchester, N.B. The mine has been idle for 15 years, but the company intends to resume operations next summer. About $125,000 will, it is said, be invested in new machinery and buildings.

It is said the Dominion Coal Company will mine 400,000 tons this winter.

J. L. Bell, advocate, Quebec, has accepted the position of assistant gold commissioner in Yukon at a salary of $4,000.

G. W. Mitchell has just returned from the Peel River. He has made a good map of the river courses in the hitherto unexplored country lying between the Mackenzie and the Yukon rivers.

D. H. Beaton, Fort William, Ont., reports that the Johnson Nickel Mining Co., St. Paul, U.S., are doing extensive prospecting for iron with a diamond drill on the Canadian border near Gun Flint Lake.

George C. Hinton & Co., Vancouver, B.C., have placed an order with the Royal Electric Co. for a 10 k.w. multipolar generator, and the necessary wiring of lamps for one of their mining camps on Vancouver Island.

A fine strike of nickel ore is said to have been made in the Fort Steele district of East Kootenay. The claim is four miles from Fort Steele on Wild Horse creek. A wagon road runs from Fort Steele directly to the property.

An immense copper belt is said to extend from White Horse Rapids, on the Yukon River, to a point on the Dalton trail, forty miles from the Lynn Canal. It is over fifty miles in extent, and lies in British territory. In places vast masses of ore yielding $60 in copper to the ton are exposed.

W. H. and J. W. Wylie, Almonte, Ont., have a gang of men taking out hematite iron ore between White Lake and Calabogie, Renfrew county, Ont. Several car-loads will be shipped to the smelting works at Deseronto for test, and if found desirable the mine will be extensively worked.

Lord Ernest Hamilton is said to have bought the Florman quartz claims at Atlin for a quarter of a million dollars. The agreement binds the company which Lord Hamilton will organize, to put up a stamp mill of large size. The group is called the Anaconda group and embraces four ledge claims, aggregating 216 acres.

J. J. Durage, Duluth, Minn., has surveyed the water power of the Seine river, Ont., from Sturgeon Falls to McManus Falls, a distance of eight miles. There is a total fall in this distance of nearly 100 feet, of which 74 feet are in eight falls. It is feasible to construct power plants for the generation of nearly 3,000 h.p. Power might be furnished for the operation of the Alice A., Gold Bug, Emma Abbot and a number of other mines near by.

The iron mine at Ironsides, Que., on the Gatineau River, four miles from the centre of Ottawa city, and known as the Haycock mine, has been sold to J. O. Hibbert, until lately of the New York and Ottawa railway. The mine has an area of 300 acres, and the ore is of the best hematite. It was operated twenty-five years ago when smelting on a small scale was carried on, and extensive shipments were made, but the price having fallen operations were suspended.

The uncovering of a solid mountain of native ferro-nickel manganese at Durango iron mountain, Mexico, has created great excitement throughout the Republic, according to the statement of Harvey Kline. Tradition has it that this enormous mass of native metal is an aerolite that fell from the sky centuries ago. It is more than 300 feet high, half a mile wide and more than a mile in length, and is estimated to contain more than 500,000,000 tons above ground. It is worth $485 a ton. A rolling mill with two large blast furnaces is now nearly completed to work on this mass of native metal, and already five cars of ferro-nickel manganese have been shipped daily from Durango to the United States and Europe.

The announcement has been made that the Dominion Coal Company has made voluntary provision for sufferers through the late disaster at Caledonia as follows: For each widow a month's pay for the first year, and after that during her life, or while she remains a widow, $12 a month. Two dollars a month for children until they are each 13 years, and after that $4 a month for the boys until they attain 14 years, and $4 a month for the girls until they attain 16 years. In cases of single men who were supporting aged or infirm parents the latter are to receive $8 per month during life. Parents who were partially dependent upon their son for support will receive $4 each per month. The payments are to date from July 1 last and continue as above.

The statement of laboratory work done at the Ontario Government Assay Office, located at Belleville, which is conducted by the Bureau of Mines as an aid to the discovery and the development of the mineral resources of Ontario, shows that 277 determinations or assays were made during the month of August. These consisted of 232 gold assays, 14 for gold and silver, 19 for copper, 7 for nickel and 2 iron ores for partial analysis. Of these 168 determinations were done for the Bureau of Mines on which no fees were collected, while 109 were for the public on which fees aggregating $130.65 were collected. As the fees are about one-half the regular rates this statement shows that the prospectors and mining men engaged in development of properties are now aware of the advantages which the office affords. The office also reported on 30 samples sent in for identification, which consists of a description of the samples with the probable metallic contents and commercial value. The samples came from all parts of the province, the gold ores from the Seine River and North Hastings districts, while the copper and nickel ores were sent from the Sudbury and Parry Sound districts.

Dr. A. P. Coleman describes a specimen of hematite iron ore, which was taken from a deposit on the claim of E. V. Clergue of Sault Ste. Marie, which is about ten miles north of Michipicoten Post. It contains 60 per cent. of iron. The deposit, according to Dr. Coleman, has an area of 350 feet by 450 feet, although late exploration shows the length to be not less than 550 feet. The deposit rises to a height of 90 feet above the level of Lake Boya, into the waters of which it dips. So far as can be seen, Dr. Coleman says, most of the deposit is high grade ore. It possesses all the characteristics of hard brown hematite, many of the specimens obtained in it showing botryoidac forms, and a variety of beautiful colors. While the percentage of iron is high, there are only traces of sulphur and phosphorus. If the hill in which it appears is solid ore, which is almost certain, the quantity in sight above the ground line would be about 1,680,000 short tons, and if it goes to any distance below the ground line the quantity would be much more. The ore in sight alone, however, should produce 1,000,000 tons of pig iron, worth, at the present United States price, $15,000,000. Dr. Coleman says none of the adjoining locations have any important ore bodies in sight, but the same formation runs through them as in the Clergue mine, to a greater or lesser extent. Mr. Healy, of Duluth, who recently acquired these properties adjoining the Clergue mine, thinks the prospects are very good. To give an idea of the importance of the Clergue mine, it is sufficient to say that a blast furnace capable of smelting 200 tons per day, and working 300 days in the year, would occupy 28 years in smelting the ore in sight. As far as Director Blue of the Bureau of Mines is aware, it is the only important deposit of hard brown hematite in the country, and it very closely resembles the rich hematite ores supplied by Malta and Cuba. The deposit is so situated that the ore can be mined very cheaply—in fact it can be mined as an open quarry, and very easily and cheaply handled. The distance from the mine to the water's edge at Michipicoten harbor is only twelve miles, and docks are to be constructed at the latter point, where it can be put on board and delivered to the furnaces at Midland, Hamilton or Deseronto. A railway is now in course of construction from Michipicoten harbor to the mines, which is expected to be completed in time to ship out a quantity of ore this season. A quantity of ore will be sent to the new blast furnace at Midland, and Mr. Clergue is preparing plans for a new blast furnace at Sault Ste. Marie.

Personal.

T. H. Wiggins, C.E., has tendered his resignation as town engineer of Cornwall, Ont.

H. Townsend, contractor for the Coast Railway construction, died of cancer at his home in New Glasgow, N.S., Sept. 8.

P. S. Gibson, Willowdale, engineer for York township, has been appointed to a similar position by King township council, York county, Ont.

Mrs. Margaret Gartshore, widow of the late John Gartshore, the pioneer manufacturer of Dundas, Ont., died at her residence in Hamilton, Ont., Sept. 2nd. Mrs. Gartshore was 90 years of age.

Capt. Lesslie, assistant instructor of engineering in the Royal Military College, Kingston, has gone to India to rejoin his regiment. He is a graduate of the Royal Military College, Kingston, Ont.

Matthew Neilson, C.E., manager of the electric railway system of St. John, N.B., visited his Almonte, Ont., relatives when taking part in the Dominion Rifle Association matches, where he showed himself an able marksman.

Fred. T. Greene, Butte, Montana, has been appointed mining engineer of the War Eagle Gold Mining and Development Co., Rossland, B.C. Mr. Greene is a Canadian, being the son of W. A. Greene, of the W.G. & R. Co., Berlin, Ont.

Thomas R. Secord died at his residence, Port Colborne, Ont., Sept. 6th. Mr. Secord was inspector on the Welland Railway during its construction, but in April, 1861, he was appointed deputy superintendent of the Welland canal, which position he held until about two years ago.

E. Andrews, M.E., a graduate of the School of Practical Science, Toronto, who has been on the assay staff of the War Eagle Mining Co. at Rossland, B.C., for the past year, has gone to McGill University for post-graduate work in mineralogy, the facilities offered for study there under Profs. Harrington and Adams being unequalled elsewhere in Canada.

Canada can claim a share in the praise that is being given the steamship "Oceanic," as its designer, the Right Hon. W. J. Pirrie, is a native of Canada, having been born in the city of Quebec in 1847. After completing his education at the Royal Belfast Academical Institution, he devoted himself to engineering and shipbuilding. He is now chairman and principal of Harland & Wolfe, Ltd., and has designed and built some of the largest and fastest steamers afloat, including the "Majestic," "Teutonic." "Canada," "Cymric" and "Pennsylvania."

John W. Bell, B.A.Sc., lecturer on mining and metallurgy in the Faculty of Applied Science, McGill University, has resigned, and accepted a position with a large mining concern in British Columbia. His resignation is a loss to McGill, from which university he graduated in 1897, and with which he has since been connected in the capacity of demonstrator and lecturer.

Jas. Poole, chief accountant of the Goold Bicycle Co., Brantford, Ont., has received a similar position with the Canada Cycle and Motor Co., and a short time after the appointment received by express a very handsome and costly silver service, without any intimation as to who the donors were, although it is presumed it came from the employees of the Goold Bicycle Company.

The Fairbanks Co., Montreal, has made a contract with the Foster Engineering Co., Newark, N.J., for control for the Canadian market of their product, consisting of pressure regulating or reducing valves and pump governors. Howard C. Foster, a son of the manufacturer of these goods, has taken a position as salesman with the Fairbanks Co., and will give his time to these goods in connection with the Fairbanks steam specialties, which are already so widely known.

Surg.-Lieut. Bertram, whose fine work at the Bisley ranges was commented upon in the last issue of The Canadian Engineer, was given a royal reception on his return to the town of Dundas, Ont., Sept. 6th. There was a torch-light procession with several bands, and an open air meeting, at which addresses were read on behalf of the town council and of the officers of the 77th Battalion, who also presented a silver tea service, as did also the Victoria Rifle Club, Hamilton. The citizens of Dundas, Ont., presented a purse containing $400.

W. A. Carlyle, superintendent of the Le Roi mine, is said to have accepted the managership of the Rio Pinto mines in Spain, with a salary of $25,000 yearly, which is very much greater than his former salary in Rossland, B.C. Mr. Carlyle is a Canadian, being a native of Oxford county, and a nephew of the great Thos. Carlyle. At the time of his birth his father, Wm. Carlyle, now public school inspector for Oxford county, was principal of the Central school, Galt, Ont. Mr. Carlyle, who is a distinguished graduate of McGill University, was formerly inspector of mines for the Government of British Columbia.

Railway Matters.

The G.T.R. is building a new double track bridge over the Magog at Sherbrooke, Que.

There is a strong agitation in the northern part of Quebec to secure the extension of the Lake St. John Railway to James' Bay.

A charter is to be applied for for a new line of railway between Ottawa and Brockville as an independent direct connection with Brockville and with the Grand Trunk system.

R. A. Hazlewood, C.E., has surveyed the connection between the C.A. and O.A. & P.S. Railway, and the C.P.R. at Parry Sound. The distance is almost five miles, and the link will form part of the James' Bay Railway.

A bylaw to provide for the granting of a $20,000 bonus to the Lake Erie, Tilsonburg and Port Burwell Railroad for an extension for the road from Tilsonburg to Ingersoll, was carried by a large majority in Ingersoll, Ont., Sept. 20th.

After many months of surveying and the expenditure of much money, the C.P.R. engineers have at last discovered a feasible route for a railway over the divide between the Kettle and Okanagan River valleys to the south of Camp McKinney.

The Midland Railway contractors in Nova Scotia are pushing their work, says The Truro News. The rails are now laid up to the Shubenacadie river, and ballasting is going on day and night. An electric light plant has been installed in the ballast pit at Stanley, so that night work can be pushed with redoubled vigor.

The Jenckes Machine Co., of Sherbrooke, Que., have built one of the George E. Smith power rail bending machines for Ross, Barry & McRae contractors, for use on the construction of the Great Northern Railway. The machine will be driven by a 10-h.p. Dake engine, the steam being taken direct from the locomotive.

The Algoma Central Railway has 500 men employed in the construction of a twelve-mile section of the line from Michipicoten Harbor to the iron mines owned by the company. The exceptional activity of the company, despite the scarcity of labor, is explained by the fact that a contract has been entered into with the Midland smelter for the supply of iron ore this fall. The rails will, it is said, be laid by November 1.

The Canadian Pacific Railway Company has received advices to the effect that the work of construction on the Columbia and Western Railway is now almost completed, and it is expected that trains will be running into Midway before winter. This road, which has been constructed by the Canadian Pacific Railway Company, opens up the famous Boundary Creek mining country. It runs from Robson, on the Columbia River, to Midway, on the Kettle River, a distance of 100 miles. T. G. Shaughnessy, president of the Canadian Pacific Railway, said recently: "The grading of the road into Midway has been completed, and there remains only some twenty-five miles of iron to be laid before we shall have our trains running into the town of Midway. The work on the big tunnel, 30 miles west of Robson, where we have pierced for 3,000 feet the side of a mountain, is not quite completed, but the completion of the work there will not prevent the running of trains from Robson to Midway this autumn. In addition to the main line, we have constructed some thirty miles of sidings along the line into mining camps, where the development has been sufficient to warrant us in going to that expense. This road is, by all means, the most expensive the Canadian Pacific has ever constructed. The country throughout the entire distance is exceedingly difficult, and the engineering difficulties very great. The entire line has cost the company in the neighborhood of $40,000 a mile, or a total expenditure of nearly $4,000,000 for 100 miles of line. The company received no subsidy. The Boundary Creek country promises to be one of the richest mining countries in British Columbia, and though the road has cost the Canadian Pacific a very large amount of money, there is no doubt that the business over the road, as soon as the mining properties along the line are opened up and developed, will be very large."

The Rainy River Railway will open up a great extent of rich mineral country. Commencing at Stanley, up to which point it has running powers over the Port Arthur, Duluth & Western Railway, the line runs close to Kakabeka Falls, a vast water power, and proceeds through the east end of the Matawin iron range, which is twenty miles long, of which two-thirds is soft hematite, and the remainder, at the western end, magnetic. Skirting the Shebandowan and Kashabowie lakes, the line then passes through a copper region, the most known mine in which is the "Tip Top," having a vein of a hundred feet wide; thence it runs close to Moss township, where there are several gold locations, not at present being developed. The line next passes close to Lac des Mille Lacs and Partridge Lake, twelve miles to the south of the Saw Bill mining region, running nearly parallel to the Ati-Kokan iron ranges, a distance of twenty miles. It is stated upon excellent authority that here is the largest iron deposit in the world, there being in one place 2,000,000 tons of iron ore in sight on a plot of 160 acres. The Seine River waters are next reached, which will give ready access to the mines, and here there are many valuable water powers. Running along the Seine River valley, the line goes near to Bad Vermilion and Little Turtle lakes, where it will cheapen supplies for more than a hundred prospects and mines, the principal of the latter at present being the Golden Star and the Olive. It next runs along Rainy Lake, crossing the western arm of the same on a succession of six islands, two miles west of Pither's Point, necessitating the building of five bridges. Between Pither's Point and Fort Frances is an excellent site and prospect for a large city, the Couchiching Falls being estimated to supply a water power of fully 50,000. From Fort Frances the line runs along the Rainy River, where there is a large area of fine agricultural lands, and reaches Hungry Hall, at the river's mouth. Here the line leaves Canadian territory until it reaches Buffalo Bay, a distance of 35 miles, and enters Manitoba at the latter point. The land is well wooded from Buffalo Bay to Winnipeg, and considerable revenue has been derived from this source to assist the 60 miles of railway already constructed. Besides the subsidy proposed for this Rainy River Railway, the Government has included a subsidy in the estimates for 40 miles of the 160 miles of the proposed Central Algoma Railway, and if these two lines should be built, as now seems almost certain, they will not only help to develop the interior of New Ontario rapidly, but may be expected to act as great feeders to the St. Lawrence route.

THE STOKER CASE.

Our readers will remember an action taken by the General Engineering Company, of Toronto, against the American Stoker Company, of New York, and the Dominion Cotton Mills Company, of Montreal, which has been pending in the Canadian Courts for more than a year past. This was a suit brought by the plaintiffs against the two defendant companies for damages for infringement of the Jones Underfeed Stoker patents, and for an injunction to restrain the defendants from using these stokers in Canada. The case was regarded as a very important one to manufacturers, and both parties to the suit had retained eminent counsel. J. L. Ross, of Rowan & Ross, Toronto, and C. A. Duclos, of Atwater & Duclos, Montreal, appeared for the plaintiffs, while Donald McMaster, Q.C., of Montreal, and Gifford and Bull, of New York, represented the defendants. The trial lasted four days. The action was a test case, the object of which was to determine the validity of the Jones' patents, not only in Canada, but for the whole continent of America. The judgment of the Exchequer Court, in which it was brought, was a very strong one, and Mr. Justice Burbridge upheld the validity of the Jones patents, and granted the injunction asked for, with damages. These damages were not fixed at the time, but would depend on the number of the defendant's stokers set up in Canada. The total damages would probably reach $10,000, or over. The defendant's, however, are continuing the litigation in another form on a point raised by them since the previous action was decided, and have obtained a stay of proceedings in the main action by putting up a bond in the American Surety Company for $5,000. The result of the action will be of considerable interest to owners of Canadian patents in general. Up to the present the General Engineering Company have succeeded at every stage of the legal contest.

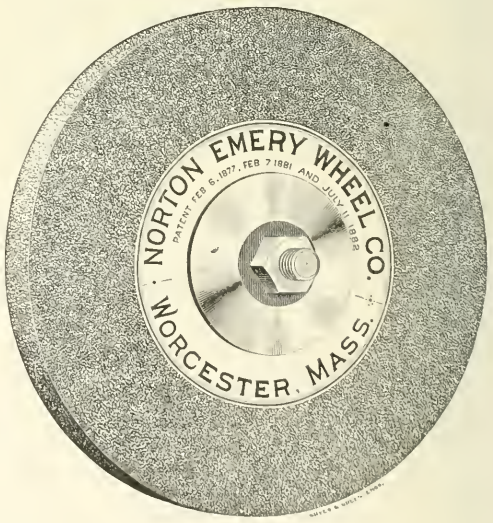
—One of the oldest bridges in Europe is soon to disappear, under the demand for better navigation of the river it spans. This is the stone bridge, with fifteen arches and a total length of 994 feet, built across the Danube at Regensburg (Ratisbon), in Bavaria, by Duke Henry the Superb, in 1135-1146.

WANTED—Young man familiar with installing and repairing electric recording meters. Give particulars of experience. Only hustlers and first-class penmen need apply. Advancement if satisfactory. Address "WATT," Canadian Engineer, Montreal.

WANTED—A First-class Mining Foreman, who has had experience in Galena, Zinc and Silver Mining. Send references and rate of wages expected to P. W. RESSEMAN, 31 Central Chambers, Ottawa, Ont.

FOR SALE

A good Water Power, 500 horse, situated one-half mile from railway, every facility for making siding to power. Address
J. D. THEUNISSON, Cookshire, Que.



The Fairbanks Company,

749 CRAIG STREET,

MONTREAL

PIPE AND BOILER COVERINGS

Engine Packings, Oils, Cotton Waste, Etc.

Eureka Mineral Wool & Asbestos Co., Toronto

The Canadian Engineer

VOL. VII.—No. 7. TORONTO AND MONTREAL, NOVEMBER, 1899. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.
OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR
R. R. SAMUEL
Address—Fraser Building, Montreal, Que.

Toronto Telephone, 1392. Montreal Telephone, 2589.

UNITED STATES AGENT:
H. E. BURNETTE, Cor. Fourth and Locust Sts., Philadelphia.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Accidents of the month	209
Bunsen, Professor, The late	189
Canadian Association of Stationary Engineers	193
Carbon Duties Discrimination in	195
Catalogues, New	192
Coke, Advantages of, over coal as a fuel for generating steam	195
Coke Works, The Everett	202
Corliss Engine, Excessive Heating in a	186
Draughting	197
Drill and Ratchet Screw Drivers, New Reciprocating	199
Economizer Green's	192
Electric Flashes	208
Engineer's and Electrician's Hand Book, The, A Reference Directory	201
Engineer, Report of the City, Toronto	189
Exhaust Head, A New Form of	189
Fire Prevention Committee, The British	201
Greening Wire Company, Limited, Origin of the B	200
Industrial Notes	203
Iron and Steel	207
Literary Notes	198
Marine News	205
Metric System, The	190
Metal Imports from Great Britain	197
Mining Matters	205
Motor, The Diesel Heat	186
Pavements between Street Railway Tracks	199
Personal	206
Petrolia and the Standard Oil Company	209
Practical Man, The	191
Railway Matters	206
Reed Manufacturing Company, The, Erie, Pa	195
Sanitary Necessities	181
Sewage Treatment, Septic Tank System of	192
South Africa, Its People and Trade	182
Standard Oil Company, Enter The	185
Steam Wagons, American	185
Trip to the Yukon in 1905—A Fancy	xi
Water Curtain, The	192
Water, Sand Filtration of Public Water Supplies	197

SANITARY NECESSITIES.

BY W. M. WATSON.

I have lately received a couple of clippings out of the Montreal "Witness," from a friend, together with a mild request that I should express my opinion on the facts they contained, publicly if I had the opportunity. Probably if I fully complied with the gentleman's wishes, I might place myself in a similar position to that of a plaintiff, who was addressed in the following words, by a late chief justice in England, when appealing the heavy damages that the jury had inflicted upon him for libel, viz.: "My experience in this court of such cases as yours is, that the law is too often used to punish the person who is unwise enough to speak the truth."

The clippings give the remarkably high death rate in Montreal, comparing the figures to the death rates of similar large cities, which are about one-half as heavy. If Dr. Reid, who prepared the statistics, would go a little farther and tell the public the actual death rate of the English-speaking citizens, and that of those who speak other languages, a little more light would be shown to an outside reader. Let Dr. Reid turn up a Montreal "Star," dated November 4th, 1885, and he will find that the statistics prove that the mortality for October in that year was 1,391; out of this number 1,286 were French-Canadians, 65 others belonged to the Catholic faith, and only 40 out of the whole number were English-speaking Protestants. That was the time when the preventable disease of smallpox was epidemic in Montreal. Between the fine houses of Montreal, among the wealthy, and those of the very poorest of the working-class is found a very unnatural gulf. The first-named class is allowed from 600 to 6,000 cubic feet each of enclosed air space to live in. They are heated in cold weather, by that healthy apparatus called low pressure, indirect, hot water heating, which gives them a splendid ventilation, as well as a warm, soothing temperature. They enjoy the best sanitary appliances, and take daily baths. They are surrounded with appointments that are pleasing to the eye, and are served at table by expert cooks. There is, within one mile, a large manufactory of white lead, etc., the men who do the work and benefit the general public live near the works, in houses built over swamp-holes; they have not a single thing within sight of their windows that has a pleasant effect; they possess no gardens or flowers. The rooms and rear yards are so small that in place of having the regulated amount of 600 cubic feet per head of interior living space, they cannot measure more than 200. In winter they crowd together in one room, with every crevice where the air can pass in and out of the room to change the sickening atmosphere pasted up with paper. Their heating is done by the air passing over the red-hot plates of an iron stove, which destroys the air that the inhabitants should be breathing, and the inmates are gradually destroying their own respiratory organs and poisoning their blood. The poison these workmen are liable to, when working, gives them but a short time to live, but this time might be largely extended, if the city authorities would do their duty. Why should the street opposite the doors of the poor dwellings be ankle deep in mud and festering garbage. The area around their houses should be considerably larger than at present, and the houses built on clean and wholesome foundations. Could not the City Council afford to give such working-men good swimming baths in each district, handy to get at, and provide for everyone to enjoy, at a small, but probably paying-price, a good wash. I know that many people will remain in a stifling room with apparent enjoyment, that other people would not tolerate one hour; and this is probably the reason why our French brothers suffered so badly in the year 1885 from smallpox, and are at present in a lesser degree doing the same each year. This is not the fault of themselves, or anything in their social or religious life, but of the shameful and openly corrupt city government. But while it pampers the class that is wealthy enough to pamper itself, it cares nothing for the poor, and still allows the barbaric system of earth cesspools to do duty for privies, to foul the soil the people live on, and to emit a united sickening odor into the air the unfortunate inhabitants are compelled to breathe.

The editor of the "Witness" tells us that the water supply is bad, that foul sediment is stored in the reservoir. Now the motto for all waterworks is to keep scrupulously clean the interior of all water pipes and tanks containing drinking water; I believe that there are no clean-out valves on the water mains of Montreal, therefore, the mains cannot have been properly cleaned since they were laid down. We are told that there is putrid matter or foul sediment in the bottom of their reservoirs; if so, then there is similar foul deposit in all the water mains. Why does not the "Witness" call for pipe cleaning as well as the reservoir cleaning? Simply because they cannot see inside the pipes, but can see inside the open reservoir. The pipes have been down a number of years, and the foul stuff in the bottom may be impregnated with disease germs, and will grow worse as time passes.

The end of a very long line of water pipes should be cut, and a full-sized valve placed on it, then a good drain made to receive the waste water; when this is done then leave the valve full open and open the turn-off valve at the intersection with the trunk water main quickly, so that it will cause a great commotion inside the water mains, with the air the mains will then contain, so that the dirt will fly before the body of rushing water to the wash-out valve, and by the time the body of water reaches that point, the interior of the pipes will be clean, and comparatively only a few gallons of water used. If the pipes of Montreal were laid on the circulating system, they should be divided at prominent places where they will be able to flush the longest length of main pipe at one time, in a similar way, as above described. The next question is, why should water, which contains such foul sediment as the "Witness" complains of, be allowed to enter the water mains, Montreal having the very best facilities to hand to filter the water, the cost of which need be no more than one cent per head to build and manage. I believe I can tell the "Witness" where to find the key to the whole trouble that causes the great sacrifice of human life in Montreal, and that is the disgraceful way in which public officers are appointed. It is no secret that positions are sometimes sold at good prices, that men are engaged who know nothing of the business they are appointed to fill, nor do some of the appointees care one cent for the general welfare of the public, who pays their wages. Montreal may have the best and the most expensive appliances put down to perform its public works, but they quickly deteriorate after their completion for the need of reasonable intelligence being displayed by some of its officers, in charge, who are void of skill. In October, 1898, this paper published my description of the Montreal incinerators, and it proves what poor mechanical assistance the city pays for. It is some years since I looked over the water-works, and cannot speak as to any present details, but the complaints named by the "Witness" could be easily and quickly corrected.

The York machinery Co., composed of W. H. Stubbing, J. G. Nicholson and J. D. Bird, has started business at 833 Yonge street, Toronto, as manufacturers of laundry machinery. The firm is now making power framing machines of all kinds, hydro extractors, etc., and will make special machines to order for other lines of trade. Mr. Stubbing, the manager, reports that his shop has been very busy ever since the shop was opened.

SOUTH AFRICA, ITS PEOPLE AND TRADE.

CAUSES OF THE BOER WAR.

ARTICLE II.

In our article last month, a brief sketch was given of the beginning and rise of the European communities in South Africa. The history was brought down to the annexation and retrocession of the Transvaal. As there exists a great deal of misconception about the causes of the present war, we shall endeavor to review the main facts.

What led to the annexation of the Transvaal? It was not lust of gold, for only small alluvial diggings had been found as yet, and the great gold reefs of Johannesburg were then as little dreamt of as the Klondyke of Canada. It was because the Republic was bankrupt, the Boers in many districts having refused to pay any more taxes, the country reduced to a state of anarchy by the incapacity of its administrators, by factions bitterly antagonistic to each other, and threatening civil war, and the failure of the Boer commandos to subjugate the native Chief Sekukuni, who was bringing other native tribes down upon the territory, the principal danger being threatened by the Zulus, under Cetywayo. This renowned Zulu King was anxious to pay off old scores with the Boers, who had constantly encroached on his territory, and frequently captured and enslaved his people and robbed them of their cattle and lands. The British Government might have allowed the Boer Republic to find its own way out of its financial difficulties, but when it came to their relations with the natives there was danger that once the Zulu King had overrun the Transvaal, with his 40,000 warriors, he could not restrain his army at that achievement, but it would then turn upon the British colony of Natal, which was neighbor to both, and which then had a white population of only 30,000, against a native population of 300,000. Under these circumstances, and considering that a petition for British intervention had already been signed by 3,000 out of 8,000 of the voters of the country, Sir Theophilus Shepstone, who had been authorized by the Home Government to act as he thought wise, annexed the country, without any force other than a personal escort of twenty-five mounted policemen. The British then took in hand the conquest of Sekukuni, which the Boers had failed to achieve, and then had to deal with Cetywayo, who, robbed of his revenge upon the Boers, now turned sullen towards the British. The next act in the drama was the great Zulu war, which was fought with no help from the Boers, except that given by a single family, Piet Uys, and his sons. These people, forgetting their rescue from certain destruction at the hands of the Zulus, no sooner found this dreadful menace removed, than they began to agitate against British rule. As stated before, they had one real grievance in the dilatoriness of the Imperial Government in granting them a local legislature; but this at last was being framed when rebellion was brought about through the enforcement of taxes, which the Boers refused more obstinately to the British than they had done to their own authorities.

The Government Treasury notes or "blue backs" then sold at a shilling, or say five cents on the dollar, while the salaries of the civil servants were three months in arrears.

These papers have been issued in pamphlet form, containing a glossary of Cape Dutch and Kafir words and phrases in common use. Biggar, Samuel & Co., 62 Church Street, Toronto. Forty pages. 10 cents.

In this rebellion they were led by a man, who, when the history of that land comes to be written, will be set down as the evil genius of the Dutch race in South Africa—Paul Kruger. This man, who was born a British subject in the Cape Colony, first came into prominence among his countrymen as a hunter and fighter—a fighter first against the Kafirs and then against his own people, as well as the English, whom he hates as cordially as the British sailor of Nelson's day did the French and Spaniards. It seems curious that a man of Kruger's pretenses to piety should be so tenacious of liberty and natural rights for himself and his fellow-Boers, and yet refuse the most elementary rights to British people in his country; and that he should see nothing but iniquity in Dr. Jameson's quixotic dash to rescue the Outlanders from misgovernment, and yet see no wrong in his own invasion of a friendly State with no better motive than a lust of power. Some forty years ago, at a time when the Transvaal and the Orange Free State (a neighboring Republic, composed of his own fellow-countrymen), were at peace, Paul Kruger formed a plot with M. W. Pretorius, another Boer leader, to overthrow the government of the Free State. While Kruger invaded the country, at the head of a commando, inciting the Free State Boers to rise, as he proceeded, Pretorius was set to instigate the Free State natives to revolt. The Free State forces were, however, brought together in much quicker time than he anticipated, and when Kruger saw himself confronted with double the number of cannon his own force had, he discreetly withdrew.

That Kruger's intrigues during the days of the first Republic were a cause of the country's troubles is shown by the statement of the last President, Thomas Burgers,* who, referring to the events that led up to the annexation, said: "Fruitlessly did I press upon him (Kruger), the fact that by showing how our danger lay in want of unity, the British Government would have cause to step in, on the ground of humanity, to avert civil war, and to present a general rising of the natives. * * He would not hear of retiring. Had I not endured in silence, had I not borne patiently all the vile accusations, but out of selfishness or fear, told the plain truth of the case, the Transvaal would never have had the consideration it has now received from the British Government. However unjust the annexation was, my self-justification would have exposed the Boers to such an extent, and the state of the country in such a way, that it would have been deprived both of the sympathy of the world, and the consideration of English politicians."

After the annexation, he was appointed field cornet (a position corresponding to our sheriff, but including also the duties of tax collector and other functions), of his district, at a salary of £200, which in those days was a good income. By false representations, however, he drew £300, or what came to the same thing, withheld tax moneys to that amount over his salary. The administration called upon him to make good the amount, but he did not do so then, or since. He only met the Government's request by demanding an increase of salary! The correspondence in the case is on record. How much the consciousness of this fraud had to do with the intrigues he engaged in against the British Government, it is hard to say. At all events, while holding an office under the British Government, he was engaged in agitations against it, and became the leader in the armed rebellion that followed. After the British defeats in the skirmishes at Laing's Nek, Majuba Hill and Ingogo, and while British reinforcements, to the number of 10,000 men, were gathered, the Gladstone Government stayed the sword-arm that was ready to strike back, and an armistice was arranged, followed by the convention of 1881, by which the Republic was restored, subject to the suzerainty of the Queen. By this instrument, the right of internal self-government was given to "the inhabitants" of the Transvaal, without prejudice as to nationality, and in the discussions by which the intent of its provisions was explained, Mr. Kruger distinctly declared that all would be put on an equality, as regarded the franchise and other rights. These discussions were taken down at the time, and form part of the records in the colonial office. At that time the Boers were in a large majority, and it is possible Kruger might have kept faith had the population remained thus, but Englishmen began to come to the country in greater numbers, and in 1886 the discovery of the now celebrated Witwatersrand gold fields brought people from all quarters of the globe, until the alien or outlander population, which of course included Englishmen, outnumbered the Boers. Kruger had from the first aimed to keep all power in the hands of the Dutch, and hence began the evasions and trickery by which the plain intentions of the negotiators of the original convention were to be thwarted. His ambition did not stop here. He purposed the formation of a great military state, which would centralize the Dutch influence in South Africa, and establish a Dutch republic extending from the Cape to the Zambesi, with Pretoria as the capital. For a long time this ambition, though steadily pursued, was concealed, and even now there are many well-informed public men in England and America who have either not grasped the situation or refused to believe the designs so steadily pursued by this cunning trickster. The people of the Orange Free State, under the misguiding influence of their present head, President Steyn—a third-rate attorney, possessed of none of the commonsense statesmanship of the late Sir John Brand, who so wisely guided the little State for twenty-five years previously—were easily led into these designs, and in the Cape Colony, the widespread ramifications of the Afrikander Bond—a sort of granger organization, having for its motto: "Africa for the Afrikanders"—afforded good ground to work upon, as its membership was almost exclusively Dutch. The plan, as regarded Cape Colony, was to overturn British authority gradually, allowing Britain to retain the

* In the course of his last address to his Volksraad, President Burgers said: "I would rather be a policeman under a strong government than the President of such a state. * * You have ill treated the natives, you have shot them down, you have sold them into slavery, and now you have to pay the penalty. * * The fourth point which we have to take into account affects our relations with our English neighbors. It is asked, what have they to do with our position? I tell you as much as we have to do with that of our Kafir neighbors. As little as we can allow barbarities among the Kafirs on our borders, as little can they allow that in a state on their borders anarchy and rebellion should prevail. * * To-day a bill for £100 was laid before me for signature, but I would sooner have cut off my right hand than sign that paper, for I have not the slightest ground to expect that when that bill becomes due they will be a penny to pay it with." President Burgers—who left the Transvaal broken hearted, not because of the annexation, but because of the intriguing which brought about the condition of things rendering that step inevitable—just before he died left a statement of the case for the benefit of posterity, in which he shows how Kruger plotted with the annexation faction in order to oust Burgers and get the presidency for himself. Kruger overdid his part, but though his ambition was balked for the time by the annexation which he did not count upon, he continued his intrigues against the British with the result which history tells.

naval station at Simon's Bay, and a certain "suzerainty," which could be strained to the breaking-point as time went on. Steyn, the Free State president, with his usual lack of diplomacy, gave a plain statement of these designs in a speech just a year ago, and anyone who studies the wording of most of Kruger's recent despatches and his replies to the enquiries of American and other newspapers, will see how he claims to act as champion of the whole of South Africa, though the difficulty is supposed to be with the Transvaal only. It was made plain to the British element in South Africa, and to the Home Government, that Britain must either make good her claim of paramountcy or give over the rule of South Africa to the Boers. As one of the Boers put it, there could not be two "bosses" in South Africa, and it became a question, which was it to be, Boer or Briton?

In pursuance of his policy of Napoleonizing South Africa, President Kruger, at the head of a delegation of three, went to London in 1884 to attempt to get a release from all semblance of British control, and to get a formal confirmation of the encroachments he had been making on independent native tribes since the convention of 1881. He represented to Lord Derby, the Secretary of State for the colonies, that his burghers were discontented under the existing convention, which they felt implied interference with their internal affairs. The deputation drew up a draft of a new convention, in which the name of the Transvaal was changed to the "South African Republic," and in which the British suzerainty was expressly abolished. In discussing this draft, Lord Derby politely, but firmly, informed the deputation that "neither in form nor in substance was it such as Her Majesty's Government could agree to;" but that as the paramountcy of Great Britain was an obvious fact, and did not require a document to establish it, he had no objection to satisfying the susceptibilities of the Boers by accepting the change of name, and by omitting any specific use of the word "suzerainty," which Kruger had said was offensive to them. And so, clinging to the letter of this change, Kruger built up his claim that the Transvaal was now a "Sovereign International State," though the new convention of 1884 distinctly prevents the Transvaal from making any treaty with a foreign power without the consent of Great Britain. Without trying to define the term "suzerainty," plain men will question the "sovereign independence" of a country whose autonomy was given as an act of grace, and which could not make its own treaties. But even if there were no suzerainty, the conduct of the Boer Government had rendered it liable to be called to account in a dozen ways under common international law.

Some people ask, was not the Boer Government justified in its recent policy, by the Jameson raid? The answer to that question is that the Jameson raid was the result of Boer tyranny and misrule, and not the cause of it. Had Kruger treated the Uitlanders as white men with natural rights, and had he not laid on burden after burden, and taken away right after right, with studied hostility towards British subjects in particular, there would have been no Jameson raid. The educational restrictions, the arming and fort building, the prohibition of public meetings, and the iniquitous press law, and other grievances, all preceded the Jameson raid. The people of Johannesburg and other Uitlander centres began to despair of any action from the British Government, and yet, while agitating persistently for their rights, the majority of the members of the "National Union," formed at the time to obtain redress for the people's grievances, publicly and privately assured the President that they had no desire to upset the republican form of government. And there is complete evidence that these sentiments were genuine with the Uitlanders at that time. Dr. Jameson's brave, but quixotic raid, as it was carried out, put the people of Johannesburg in a false position, and they have been unjustly charged with cowardice. It is not denied by the National Union leaders that an agreement was made with him to come to their aid. But after smuggling in 3,000 rifles, the leaders found that more had to be done to make the rising a success—for it was intended to seize Pretoria, whose forts, then under repair, were exposed and ill-garrisoned—and so they sent word to Jameson to wait on the Bechuanaland border till they notified him. Their object was not merely to

Scene—Market Square, Johannesburg.

become better equipped for the struggle, but to declare to the world that the struggle was their own, and not brought about through an invasion. They proposed to have a new flag, so that there should be no question of the independence of the movement. Dr. Jameson, however, became impatient, and appears to have disregarded either the requests of the committee or the warnings of the Imperial Government, who wired him as soon as they heard of his intention. The reader will remember how his force of 400 or 500 men were caught by a Boer force of three times his number before he reached Johannesburg, and compelled to surrender, the leaders in the movement at Johannesburg being unaware of his approach till too late to do anything. These leaders were arrested, and, as we know, heavily fined, the fines aggregating over a million pounds, and were bound over for three years not to take any part in the politics of the Transvaal. Their tongues were, therefore, tied, and hence the false impression that has been current regarding this affair. With his characteristic cunning, Kruger sent, as mediators, three men in whom the Johannesburgers had faith, and by promises of reform, made on his behalf through them, but which he had no intention of keeping, the people were induced to lay down their arms, hoping for redress at last. The President saw that the reformers had lost the sympathy of the outside world, through Dr. Jameson's mistake, and he took the fullest advantage of the fact. He at first pleaded for delay in the execution of the reforms till the excitement of his burghers should be allayed, and when this plea was somewhat worn by time, he repudiated the promises made to the mediators. An ever-increasing revenue, squeezed from the gold fields, enabled him to add to his forts and armaments, and the Jameson raid furnished the excuse that had been wanting before. In the case of Pretoria, the capital and centre of Dutch influence, the guns were mounted pointing outward; in the case of Johannesburg, the Uitlander city, they were placed so as to bear upon the town itself. Taking advantage of the sympathy naturally aroused in the Orange Free State, he drew that republic into a formal alliance by which it bound itself to join the Transvaal in any war that might arise. Before the Jameson raid, official Boerdom was insolent enough in its dealings with aliens, but after the raid, matters grew worse.

ENTER THE STANDARD OIL COMPANY.

Many of our good friends in Petrolia seem to have taken our reference to the Standard Oil Co.'s doings in Petrolia as a reflection upon the policy of the town authorities. This is shown by the letter from Petrolia in another column. Nothing could be farther from the writer's intention. We understand that the first deal by which the great oil monopolists obtained possession of Rogers, Fairbanks & Co.'s refinery was accomplished before the people of Petrolia were aware of it, and even if they had been they could not have prevented it. When the Imperial Oil Co. of Petrolia at first declined to sell out, the Standard Oil Co. took indirect, but none the less effectual means of getting their grip on the Canadian oil trade. They not only obtained from the Canadian railways a discrimination in freight rates against Canadian producers, but induced the Dominion Government to permit the importation of oil in ship tanks and cars. Before this, petroleum and its by-products had to be imported in cans or cases of not more than fifty gallons, and duty was charged on the cases. Inspection was also required which so restricted the imports as to give the Canadian refiner at least a fighting chance. When the Standard Oil Co. sought to break down these barriers deputation after deputation from Petrolia and other oil centres went to Ottawa, showing that such a change would ruin the Canadian oil trade as an independent industry, and would sooner or later deliver the business into the hands of the American monopolists. Their appeals were unavailing, but the prophecies were speedily fulfilled; for when the Imperial Oil Co. found itself in the ditch it sold out to the Standard, and the other small refineries had to follow.

The discrimination made by the railways in favor of the American corporation has been gratefully rewarded by the withdrawal of as much of the oil transportation business as it can divert to its own vessels. Once having become possessed of the Canadian oil business the Standard Co. could not be blamed for piping its crude oil from Petrolia to Sarnia, because with the facilities of shipping in tanks which the Government has given it a great saving could be effected by having its works along the water front at the Detroit River. As to the increased price which the Standard Co. is paying for crude oil, the fact will not be lost sight of that the price the company now charges for refined oil, gasoline, benzine, etc., has been advanced about ten times the proportion of the advance in crude oil. However, it is assuring to know that the enterprise of Petrolia's citizens is carrying the town ahead in spite of fate.

AMERICAN STEAM WAGONS.

Aside from the Serpollet system of flash boiler steam engines for light vehicles, which is successfully used in European countries, steam power was used exclusively for freight wagons and heavy constructions of other descriptions until a number of New England men, mostly engaged in other forms of machinery manufacture, evolved designs of boiler and engine which have made steam available for the lightest class of road wagons. By the success of their experiments they created a new type of light vehicle, which is characteristic for this country, and is already commanding intense interest in Europe. George E. Whitney, of Boston; A. T. Cross, of Providence; William B. Mason, of Milton; The American Waltham Manufacturing Co., and the Waltham Manufacturing Co., both of Waltham, and the Stanley Brothers of Newton, were the pioneers in these improvements of steam engines, closely followed by others, who are all indebted to the early experiments of S. H. Roper, who commenced his experiments with light steam engines over twenty years ago, and continued them until his death in 1896. To this common origin in ideas, says The Cycle Age and Trade Review, may be traced a certain sameness in construction of the engine part of the various wagons produced, but notwithstanding this partial similarity, each of the patterns has a pronounced individuality due to the great variation in running gear and details which are of the greatest practical importance for the management and operation of the vehicle.

Whitney in his experiments with yacht boilers found that the single vertical tubular boiler, with flues 26 diameters in length, produce more steam per pound of boiler than any other form of steam generator with which he experimented, and he has adopted as standard this ratio of dimensions. The dimensions of the boiler are: Total height, 20 inches, with a body diameter of 16 inches. Whitney uses copper tubes ½-inch in diameter, and about 300 in number. The boiler shell and fire-box are of steel, about 1-10-inch in thickness, and the completed boiler, which weighs about 85 pounds only, is tested to 500 pounds hydraulic pressure. The steam pressure used is not high, only about 125 pounds commonly.

In Mason's wagon the same style of boiler is used as in the Stanley and American Waltham wagons, the design being

Stanley's and the work Mason's. It is in most respects similar to Whitney's, but does not have the cylinder within the steam space of the boiler as has the latter. The Mason frame consists of a girder of steel tubing at each end, supporting the axles and connected underneath by two lattice braces, each formed of two crossed rods secured at their ends to the front and rear girders, and fastened together at the crossing. The upper corners of the two girders are joined by two composite side-bars, the wagon body being secured to these side bars by clips. The general scheme of the motive part of the Mason wagon is to locate the vertical boiler under the seat, and to pivot to the front side of the boiler a frame carrying a pair of piston valve, link motion, simple, steam engines, cylinders 2-inch bore by 3-inch stroke, working downward on cranks at 90 degrees. Mason uses a 12 pound flywheel on his engine shaft, with a view to equalization of torque when cutting off very early. Besides the flywheel the crank shaft carries an 8-tooth sprocket, from whence a Baldwin separable cycle chain leads to a 32-tooth sprocket on the compensating gear case on the rear axle. The rear axle is not divided, a sleeve being used to transmit power to one of the rear wheels. To secure a ready chain adjustment, a right and left threaded strut is pivoted to the compensating gear yoke, which forms a part of the rear axle support, and reaches forward to the engine frame. As the engine and boiler are carried on the wagon body springs, this screw strut requires a universal jointing to accommodate the variations in the relative positions of the engine crank shaft and the rear axle. The engine frame is pivoted on a steam admission located a short distance to the rear of the mid-point of the piston travel, hence the entire fabric of the engine frame and the engine has a free pendulum movement on the tri-union, enabling the driving chain to be very easily adjusted to a nicety. The firing of the Mason boiler is controlled by the use of a regulator acting on a diaphragm actuating the fuel admission valve. The gasoline is carried in a copper tank under 20 or 25 lbs. air pressure, maintained with a hand operated air-pump. This air pressure drives the fluid gasoline into a horizontal vaporizing tube, reaching entirely across the fire-box, close to the top of the burner. There is no valve between the gasoline tank and the vaporizing tube, and the fuel supply regulating valve is placed between the vaporizer and the burner, and acts on the gasoline vapor, not on the fluid before vaporizing. When the pre-determined boiler pressure is reached the regulator closes the fuel admission valve completely; to avoid the total extinguishment of the fire, a very small by-pass opening is provided around the fuel valve, this by-pass admitting vapor enough to the burner to keep the burner lighted and to keep the vaporizing tube hot, so that as soon as the boiler pressure falls the fire will be automatically increased without any attention on the part of the driver. When the regulator reduces the fuel supply it also opens a large area of cold air supply to the fire box of the boiler, and thus instantly checks the generation of steam, so that the safety valve never opens to discharge any steam into the open air, which is of very great importance, as this avoids an emission of visible steam, and also avoids a waste of boiler feed water, both very desirable points. The gasoline is carried in a cylindrical tank, located well forward, under the foot-board. The water tank is in the rear of the boiler. The boiler is clothed first with sheet asbestos, 1/8 inch thick, then with hair felt 5/8 or 3/4 inches thick. The tanks are of sheet copper. The smoke bonnet leads horizontally to the rear, and has an upwardly directed rectangular opening or smokestack, not more than an inch high, projecting a very little above the rear body cover. This smoke discharge is supposed to be of use when the wagon is standing still and the fire is burning. The smoke-stack is also carried downward and to the right side, and terminates in a downwardly opening, cylindrical nickel-plated smoke-stack, extending about 10 or 12 inches below the bottom of the wagon body. There is no damper in this smoke duct. The exhaust pipe is carried across the top of the boiler inside the smoke bonnet, and terminates in a nozzle directed downward into the cylindrical smoke stack mentioned; and when the engines are running there is a very perceptible down-draught through the rectangular hole at the rear of the smoke bonnet.

The Legislation Committee of the Trades and Labor Council, Toronto, waited on Hon. John Dryden recently, to ask that certain clauses in the Ontario Factories Act be rigorously enforced. They want a blower attached to all dry emery wheels

EXCESSIVE HEATING IN A CORLISS ENGINE.

Editor CANADIAN ENGINEER :

What is the correct lead to give valves of a cross compound Corliss engine, driving air compressors direct connected to the piston rods ? What would be the pressure on crank pins when thus connected, and would this pressure on crank pins be sufficient to cause excessive heating ?

Toronto, October 15th, 1899. ENGINEER.

THE DIESEL HEAT MOTOR.*

The Diesel motor has attracted more or less attention for the last two years, but the principles upon which it operates, and which are so widely different from other motors, have not been generally understood. Hirn's work at Mulhouse, Professor Lanza's work in Boston, and Isherwood's practical experiments, roused mechanical engineers to the importance of considering the utilization and conservation of heat in the steam engine as the fundamental question of design. Even Ericsson, one of the pioneers of the steam engine, had previously turned to the hot-air engine to escape from those losses inseparable from the employment of steam. Naturally enough, then, many scientists and inventors turned again to the internal combustion engine, which had been previously experimentally developed by Barnett in England, Drake in America, LeNoir in France, improved by Brayton, Barsanti, and others, ably discussed and advocated by Dr. Siemens, and finally developed into a practical working machine by Otto in 1876. Otto's master patent, though at first vehemently attacked, became the foundation on which Priestman, Crossley, Atkinson, Capitaine, Clerk, and others, built up a number of types with a gradual and satisfactory increase in economy. But they all worked in the beaten path of mixing a charge of gas and air, carefully compressing it, and igniting it for explosive action by various igniting devices. Not one attempted a vital change in the cycle itself until Rudolph Diesel, in 1893, proclaimed his method and attempted the development of a practical working engine on the ideal of Carnot.

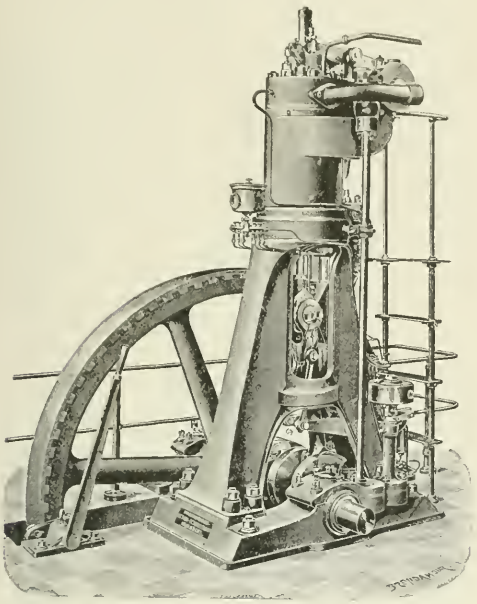
After experimenting with various vapors more permanent than steam, and at first attempting both to add and withdraw the heat from the working fluid from without, he reached the conclusion that the atmosphere about us would furnish a cheap, endless supply of permanent gas, available not only as the vehicle of heat, but as the means of evolving it from the fuel employed.

Rudolph Diesel is a Bavarian, 40 years old. He received his early education in Paris, where his parents then resided, until they were forced to emigrate in 1870 by the decree of the empire. He is a man of studious habits, a good mathematician and thoroughly versed in the science of thermo-dynamics, which he has made his life study. As a student at Munich he was a pupil of the celebrated Professor Linde, now well known as the inventor and builder of the ice machine which bears his name. Since the publication of his lecture of June 16, 1897, he has been fairly overwhelmed with praise and congratulations by the leading professionals of Europe. For the past fifteen years Mr. Diesel has devoted himself almost entirely to this work. He even built a small experimental motor in Paris many years ago, the working of which enabled him to modify his first theories considerably. He, however, took the precaution to have the parts of this motor made in different shops to prevent his ideas and processes from becoming known. In 1892 he made his applications for his first patents in different countries. On the 16th of June, 1897, he delivered a lecture before the National Society of German Engineers at Cassel, in which he not only developed his theories, but exhibited in drawings the actual construction of his motor, and gave some data in regard to the practical results obtained at Augsburg. Professor M. Schroeter followed Diesel in further development of the theory of the motor, and gave in detail the results of tests made by him on the first experimental motor, and stated his conviction that the motor was now ready for commercial work.

Diesel's idea was to follow Carnot's cycle strictly, obtaining the lower isothermal and adiabatic curves by compression, and the upper lines by combustion and expansion. For a long time he experimented with various vapors, which, under normal con-

*Extracts from a paper read before the Massachusetts Institute of Technology by E. D. Meier, C.E., M.E.

ditions, are far above their points of condensation. Ammonia vapors, especially, seem to have the properties best suited to the theoretical process. But great difficulties in handling them were encountered in practice. In the endeavor to replace them he was naturally lead to experiment with air. Up to this time he had necessarily applied his heat from without, and was subjected to the losses and limitations due to the metal walls



20 H. P. Diesel Motor—German Type.

through which it had to pass. He was then subject to the same losses which had defeated Ericsson, and was compelled to make the step which made his motor an internal combustion engine. Starting out, then, with the intention of improving the caloric process of the steam engine, he reached, in a round-about way, means similar to those employed in gas and oil engines. But this similarity is strictly limited to the fact of internal combustion, the method of combustion being radically different. Further, finding that to begin his compression isothermally led him into pressure which must, in our present practice, be considered excessive, he abandoned that part of the Carnot cycle, and made his compression adiabatic throughout, thus reducing the necessary pressures from over 100 atmospheres to between 30 and 40. When, as in the history of the steam engine, these higher pressures become practically feasible, a return to the original complete process may become advisable. Diesel's fundamental invention is then really a process of converting heat into work; this of course has been supplemented by other inventions naturally growing out of the persistent and logical development of a practical machine to operate on this process. It was Diesel's first intention to build a motor with three cylinders, embodying compound compression and compound expansion, and one of this type has been built at Augsburg, and is to be thoroughly tested on producer gas. But the development of the single cylinder type has been so satisfactory, and the demand for them has become so great, that at present the German shops are busy to their fullest extent, building their simpler form. As this form has reached an absolute efficiency of 30 per cent., and is in every way a simple and practical machine, there is at present no reason for developing the compound motor. The cut here given represents the first of these 20 h.p. motors, built by the Nuremberg Machine Works. This motor was exhibited at the Electrical Exposition in New York city, held in May, 1898. In appearance it resembles a vertical marine engine. A strong base plate supports the main journals of the crank shaft, outboard bearings being provided for the shaft extensions which carry the fly-wheel and pulley. Bolted to the base plate is a stout A. frame, containing the guides. In the rear leg of this frame a small air pump is supported. On the top of the frame is placed a cylinder open at the bottom. Its top is closed by a head cast in one piece, in which are contained one suction valve for air, one discharge valve for spent gases, and a needle valve for the fuel. The admission to the casing of this fuel valve is controlled by a stop valve, which can be instantly closed to shut off the supply of fuel. Besides this, there is a starting valve used only in starting the engine. Cylinder and air pumps are water jacketed. This water jacket was not used in the earlier experimental engines, but is found advantageous in keeping the temperature of the working parts uniform. As the temperature of combustion is so much lower than that of the explosion type of engines, a much smaller amount of water suffices for this. In the earlier German engines the main shaft and crank are bored for water cooling. This, however, grew out of the practice of Krupp's Steel Works of boring all small shafts produced. The practice has been discarded in England and in America as unnecessary. The air pump is driven by a set of levers attached to the main cross-head. Conveniently placed to one side is an air vessel known as the starting tank, connected by copper pipe to the air pump, and to the fuel valve casing.

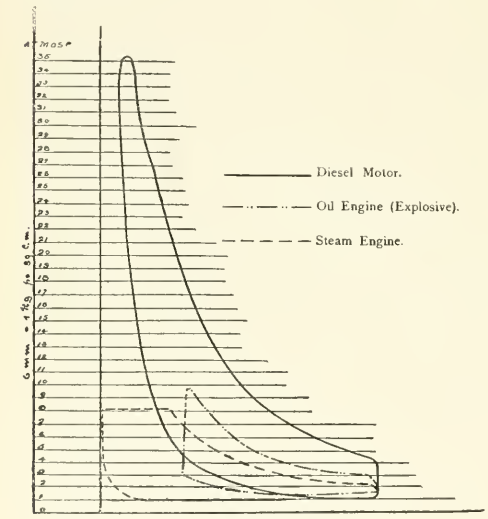
The operation is as follows: On one down stroke the main cylinder is completely filled with pure air; the next up stroke compresses this to about 35 atmospheres, creating a temperature more than sufficient to ignite the fuel. At the beginning of the next down stroke the fuel valve opens, and the petroleum atomized by passing through a spool of fine netting (wire), is injected during a predetermined part of the stroke into this red-hot air, resulting in combustion controlled as to pressure and temperature. This injection is made possible by the air in the starting tank, which is kept by the small air pump at a pressure some 5 to 10 atmospheres greater than that in the main cylinder. A small quantity of the air enters with the fuel charge, which it atomizes as described. When the motor is running at full load a very small quantity of injected air suffices, and the pressure in the air tank steadily rises. At half-load, with less fuel injected, more air passes in. For this reason, the starting tank is made large enough to equalize these differences, and a small safety valve is provided on the air pump. The petroleum is pumped into the fuel valve casing by a small oil pump, bolted to the base plate. This pump is arranged to pump a fixed maximum quantity of petroleum. A by-pass is provided so that this whole quantity, or any portion of it, can be returned to the supply tank. The governor controls the action of this by-pass valve, closing it just long enough to compel the exact quantity of the fuel required to pass into the fuel valve casing. As this requires only the movement of a small light wedge, the regulation is accomplished with great exactness. In this regulation resides a great advantage for the Diesel motor. The full charge of air being always supplied for complete combustion, it matters not whether the governor permits one or fifty drops of petroleum to enter the working cylinder at each motor stroke; the combustion is always complete. Thus variations in excess of air over that theoretically necessary, from 26 to 116 per cent., have been measured, and the analysis of the spent gases shows no trace of unburnt carbon or hydrogen. It is hard to conceive a more perfect combustion than that which takes place when fuel is sprayed, finely powdered or atomized into red-hot air, just beginning to expand. To stop the motor it is only necessary to close the valve which admits the petroleum into the fuel valve casing. The valve gear consists of a series of cams placed on a shaft and journaled on brackets cast on the cylinder.

In starting the motor a hand lever is pulled to one side, throwing all these cams, except the exhaust valve cam, out of gear, and throwing a special cam into gear with the starting valve. A few strokes of the petroleum pump by a hand lever inject a small quantity of petroleum into the fuel valve casing. The fly-wheel is thrown over by a lever a trifle beyond the upper dead point. The fuel throttle valve is opened, and by a turn of the hand wheel communication is established between the air tank and the starting valve. A single charge of highly compressed cold air enters the cylinder, sufficient to give two revolutions of the fly-wheel at moderate speed. At the close of the first revolution the starting valve cam is automatically thrown out of, and the other cams into, gear, and thus on the second revolution a full charge of air is drawn in and compressed, and in less than thirty seconds the motor is running at full speed.

Mr. Diesel makes a sharp distinction between the tempera-

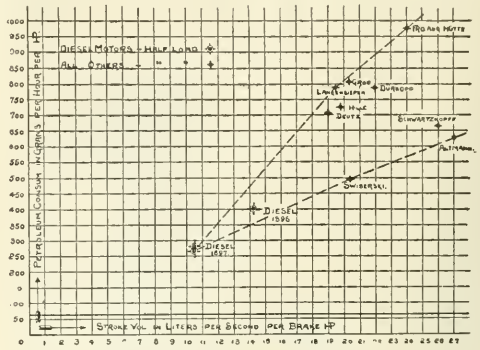
ture of ignition and the temperature of combustion; the first is a constant value at each pressure, and dependent only on the physical qualities of the fuel, the higher the pressure the lower the temperature of ignition. The temperature of combustion on the other hand is variable, depends on many conditions, and especially on the quality of the air by which the combustion is maintained, but it is always higher than the temperature of ignition. Diesel's radical departure from all previous practice is in generating a combustion temperature by mechanical compression of pure air, utilizing this temperature to ignite the fuel, and by so introducing the fuel that the heat lost by expansion is practically balanced by the heat added by combustion.

Before the completion of this perfect engine, certain critics of Diesel's theories contended that the dimensions of the cylinder, and all other working parts would become so great as to make it impracticable to build such engines. But in Diesel's engines the increase and the decrease in pressures are so gradual that there is no shock. The change from one to the other is always accomplished at a dead point. In all motors relying on explosion for their moving force, and even in the steam engine, there is a direct blow at the moment of ignition or admission. I present here a drawing on which indicator diagrams of a high pressure steam engine, of an explosion type motor, and of a Diesel motor have been drawn, based on the same piston displacement.

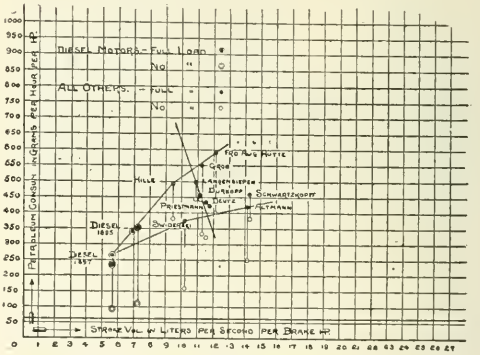


Comparative Diagrams—Diesel Motor Oil Engine and Steam Engine.

Diesel's and the explosion motor diagrams can be directly compared, since both work on the four-stroke cycle. The steam engine diagram should be quadrupled. This disposes of the objections just referred to. These second and third diagrams are graphic comparisons of the Diesel motor, with a number of the best petroleum motors as to economy in fuel and volume swept by the piston per second. They are given on the authority of Professor Hartmann, well known as a careful and conscientious observer in this field. The abscissae represent piston displacement in liters per second, the ordinates petroleum consumption in grams per hour, both figured on the effective or B.H.P. The full lines embrace the results for full loads, the dotted lines those for half loads. The comparison is between engines which burn ordinary safe lamp petroleum and kerosene; results obtained on benzine or naphtha are not considered, since motors depending on such dangerous fuels can never be generally adopted for industrial purposes. The calorific value of these highly inflammable and explosive liquids is no greater than that of safe kerosene or of fuel oil. You will notice that we find the Diesel results in both cases near the apex of the angle; or plainly put, both at rated capacity and at half load the Diesel motor shows the smallest cylinder dimensions and the least expenditure of fuel. Remember that the others represent the best results from engines carefully developed and improved in all mechanical details, while the Diesel motor is but the third one ever built, and that in its construction the practical realization of the theoretical cycle was the primal consideration, mechanical improvement being left for the future commercial exploitation of the machine. Broadly speaking, the absolute



Comparative Chart—Fuel Consumption and Stroke Volume, Half Load.



Comparative Chart—Fuel Consumption and Stroke Volume, Full Load.

efficiencies of the best known heat engines of to-day range about as follows, taking into account actual calorific values of the fuel and effective or brake horse-power:

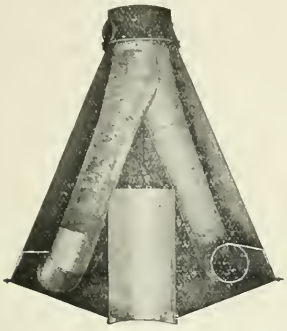
	Per cent.
Small auxiliary steam engines, pumps, etc.	6 to 10
Plain slide valve engines in good condition	3 to 5
Single cylinder Corliss engines	6
Compound condensing engines	8
Reheating compound or triple expansion steam engines	12
Best oil engines (explosion type)	16
Best gas engines (explosion type)	19
Diesel motor	28 to 30

All these are compared when running steadily at full load or rating at point of best economy. But in a large majority of the applications of all these prime movers, the exigencies of the service require them to be run frequently at three-quarters and half load for a large part of their daily service. It is conceded that in most engines the internal frictions or mechanical losses are a fixed amount, so that a loss of 15 per cent. at full load becomes 30 per cent. at half load. And thermal losses increase even more rapidly, for instance, in steam engines by cylinder condensation. In gas and oil engines the absolute efficiencies have in some cases shown a measured loss of nearly 60 per cent. In the Diesel motor the thermal efficiency is shown to increase with decreasing loads, thus counteracting in a marked degree the loss in mechanical efficiency which it shares with other machines. From a number of carefully checked tests I found the average drop in absolute efficiency from full to half load to be only 15 to 16 per cent. in the Diesel motor. So promptly and easily does it respond to a change of load that a sudden addition of 80 per cent. to the electrical load on the

Diesel motor at the Electrical Exposition at New York, by the throw of a switch, was not noticed by observers of the engines or the lights, though promptly registered by the ammeter. For variable load, then, the Diesel motor will show in practice a much greater superiority over all rivals than that apparent from the tabular figures just given.

A NEW FORM OF EXHAUST HEAD.

One of the important features of a modern steam plant is an exhaust steam pipe head. To be effective it must thoroughly separate the water from the steam, and thereby prevent the constant spraying of roofs and walls with consequent deterioration and expensive repairs. In the form of exhaust head built by the B. F. Sturtevant Co., Boston, Mass., and illustrated herewith, the principle of centrifugal force is utilized to secure perfect separation. Dry exhaust steam weighs only .038 lbs. per cubic foot, while water of the same temperature weighs 59.36



pounds per cubic foot. It is therefore evident that inasmuch as centrifugal force is proportional to the weights of the bodies in motion, the water will be thrown outward with $\frac{59.36}{.038}$, equals 1,562 times the force exerted upon the steam. In the Sturtevant exhaust head the steam passes up the interior pipes, is discharged tangentially close to the shell, and is thereby given a vigorous whirling motion. The entrained water—likewise the oil—flies outward, strikes the cool side and trickles down to the outlet at the bottom. The steam now perfectly dry, finds ready escape through the central opening above. The action is claimed to be so positive and absolute that perfect separation must be the result. These heads are built in sizes to fit pipes from 1 inch to 20 inches. All sizes above 10 inches are flanged instead of tapped.

THE LATE PROFESSOR BUNSEN.

Prof. Robert W. Bunsen died recently at Heidelberg, Germany. The age of the great scientist was 88, and he formed a most interesting link between the German scientific men of the past and those of to-day. As the obituary notice in the London Times says, Prof. Bunsen passed away full of years and of honors. He was born in 1810 at Gottingen, and graduated in the university of that town. The greater portion of his scientific researches were carried out at Heidelberg, where he held the chair of experimental chemistry from 1852 until his retirement in 1889. To enumerate Prof. Bunsen's discoveries in almost every branch of chemistry would fill a treatise. Suffice it here to enumerate those which have made Bunsen's name a household word. First came Bunsen voltaic battery, which, supplanting the more expensive form bearing the name of our countryman Grove, was generally used as the cheapest and most effective mode of generating electricity until the dynamo displaced all forms of chemical batteries. Next came the Bunsen gas burner, which, it is not too much to say, is now not only a necessity in the laboratory, but in every household and every manufactory where a clean flame is wanted. About his discovery of this simple and effective apparatus an interesting tale could be told. No one before Bunsen had thought it possible that a mixture of coal-gas and air could be made to burn without explosion from a simple tube burner. His clear conception of the laws which apply to the inflammation of such a mixture showed him that it was possible to arrange the dimensions in such a way that a steady, smokeless, and highly combustible mixture could be obtained, but a long series of delicate experiments was needed before the perfect burner which now bears his name resulted. Prof. Bunsen's work in spectrum analysis was most valuable, and his papers on this and on the many other subjects in experimental chemistry have been valued most highly by the world of science. They also resulted in honors from foreign scientific societies being conferred on their author, which were most richly deserved and were highly valued by their recipient.

REPORT OF THE CITY ENGINEER OF TORONTO.

The annual report of the city engineer of Toronto, Ont., C. H. Rust, for 1898, has been issued. It contains a great mass of information concerning matters dealt with by the engineer's department during the year. Statistics of the city show: Area, 17.17 square miles; 257.93 miles of streets, of which 179 are paved and 78 are unpaved; 82¼ miles of lanes; 230 miles of sewers, 430 miles of sidewalks, 255 miles of water mains, 230 miles of gas mains, 130 miles of underground electric conduit, 4,300 miles of overhead electric wire, 80 miles of steam railway track, 84½ miles of single street railway tracks, 7,000,000,000 gallons of water supplied annually. During the year there were 24.64 miles of new pavements and roadways constructed, as follows: Asphalt, 3.408 miles; brick, on concrete, 6.079; brick, on gravel, .352; brick, on concrete (track allowance), .413; cedar block and brick, on concrete, (track allowance), .280; cedar block, on concrete, .084; cedar block, on gravel, 4.831; macadam, 2.089; gravel, 4.756; concrete, .057. Reconstruction of track allowances—brick, 3.341; scoria, 2.986.

The engineer, referring to the increasing demand for improved roadways, says that the ratepayers are, owing to better times, beginning to realize the advantage of having a good pavement in front of their property. He mentions his disapproval of gravel roadways, as unsuitable for city streets, and he advocates discouragement of their construction. It is noted that a great many of the ratepayers have, Mr. Rust thinks, unjustly condemned cedar block pavements. The difficulty has been in the past that too long a time was given for the payment of the cost of cedar block pavements. Instead of ten years the time for payment is now five years. A cedar block pavement is cheap, easily laid and repaired, noiseless, and, dependent upon the extent of traffic, will remain in good repair for from six to eight years, and at the end of that period it can be renewed at a cost of from 45 to 50 cents per square yard, making it the cheapest pavement that can be laid, and much to be preferred to a gravel roadway, which costs about 10 per cent. more.

A large folder map is inserted in the report, which shows all the streets in the city, and they are colored to show the various pavements. Those which are in immediate need of repavement are also indicated.

Respecting poles, wires and conduits on streets, it is said that the time has arrived when strong efforts should be made to get rid of a number of poles and overhead wires, especially in the central portion of the city; and we should try and arrive at an agreement with the different electrical companies in the matter of the construction of underground conduits, which should be constructed by the city, and a yearly rental charged the different companies for the use of them. During the preceding year this department made several attempts to bring the companies together, so as to avoid the duplication of pole lines, but those efforts did not result in any satisfactory arrangement.

Mr. Rust urges improvements to the water works system, to place that branch of the city service absolutely beyond failure and guarantee an adequate supply of water for domestic and fire requirements for some years to come. Mr. Rust states most emphatically that a new conduit is necessary between the Island shore crib and the pumping station; at present the supply is endangered with low water. A large expenditure for mains, conduits and pumps, in order to place the water works in a satisfactory condition is recommended. He also recommends the installation of another 10,000,000 gallon high duty engine at the main pumping station, as an economical expenditure. A new 36-inch main is said to be required from the corner of Bathurst

street and College street to the reservoir, so as to provide a full supply for the high level district, and also to enable the reservoir to be filled in three or four instead of sixteen or twenty days, as at present; and also to enable a fire pressure to be maintained on the low level or main district at times when it may be necessary to shut down an engine for repairs at the main pumping station. He considers that a daily supply of from 14,000,000 to 15,000,000 gallons should be amply sufficient for all purposes If the present waste of water could be prevented, there is no doubt that a further reduction in our water rates could be made.

THE METRIC SYSTEM.*

In a paper on the Metric System, published in The London Times in 1896, Herbert Spencer in opposing its introduction begins by declaring that the "advocates of the metric system allege that all opposition to it results from ignorant prejudice," which he very properly declares is far from true. What is far more dangerous as an obstacle to human progress, and often far more common, is what may be called "intelligent prejudice," meaning thereby an obstinate conservatism which makes people cling to what is or has been, merely because it is or has been. It will be convenient to consider the objections offered by Mr. Spencer in the order in which he has presented them in the four separate letters which go to make up his article. Mr. Spencer reproduced in quotation a considerable part of the well-known argument of Sir John Herschel, written and widely published over thirty years ago, in which he claimed, first, that the metre was not exactly the ten-millionth of the terrestrial meridian passing through France, which was entirely correct, and that, therefore, it was not a good unit for international use, which does not at all follow. He further attempted to show that the polar radius of the earth, which could never be known except indirectly, was a better unit than the quadrant, a large part of which could be measured directly, and that this radius differed by only eighty-two yards from 500,500,000 English inches. He then proposed to increase the English standard by its one-thousandth part, so as to furnish what he declared would then be "a system of linear measurement the purest and most ideally perfect imaginable." It has always been a surprise that so able a mathematician and astronomer could have overlooked the inherent weakness in such an argument. The simple facts are that while in the beginning the metre was made to be as nearly as possible one ten-millionth of the meridian, no one imagined that it could be exactly so, or rather that we could ever know that it was exactly so. It is sufficiently near that value to be very convenient in calculations relating to terrestrial distances and areas, but it must always be considered as defined by a material standard, and no metrologist ever thinks of it in any other sense. Before beginning the exposition of his own views he ventures to quote another objector to the metric system in the person of Prof. H. A. Hazen, of the United States Weather Bureau, who some time ago argued that its adoption would necessarily include that of the centigrade thermometer scale, and that as, in his opinion, this was very bad, the metric system must be very bad.

Mr. Spencer objects to the metric system as, although it is a century old, it has not yet, even in France, entirely driven out some of the old denominations and units. In reply to this it may be said that little research is required to reveal innumerable examples of persistence in the use of words and things for more than a hundred years after their betters were available. The next objection is worthy of more serious consideration, and it has been given (for it has long been discussed) a good deal of weight by many thoughtful people. It refers to the alleged universal tendency to continual bisection, thus leading to the use of halves, quarters, eighths, sixteenths, thirty seconds, sixty fourths, and, sometimes in subdividing the inch, one-hundred-and twenty eighths. To begin with, the existence of any such inherent tendency is quite open to discussion, but, without going into that, it is at least plain that it has never shown itself in the evolution of systems of weights and measures. In all, as well as in the English money units and denominations, there is no indication whatever of this "natural tendency" toward continual halving. It is a common practice, possibly growing out of a tendency in some degree natural, to continually bisect a single unit. What possible objection can there be to speaking of a half or a quarter or an eighth of a mile or rod or yard or inch, if one wishes to do so? And no more can there be to a half, quarter, eighth, or sixteenth of a kilometre, kilogramme, metre, gramme, centimetre, millimetre, etc., nor, again, to the use of such fractional parts as thirds, fifths, or sevenths, if they seem to be desirable. But to compare the two systems in this respect one should undertake such a problem as finding the value of a third, quarter, fifth, or eighth of a mile or a ton in rods, yards, feet, and inches, or hundredweight, pounds, ounces, drams, and grains, and then do the same thing in the metric system. The enormous superiority of the latter will at once be revealed. On the other hand, it cannot be denied that there is, and has been for many years, a strong tendency toward the decimal subdivision of single units, even among users of our own clumsy system of weights and measures. In weight, for instance, in the United States it has been long ago decided that a hundredweight shall be a hundred pounds, as its name implies, and not a hundred and twelve as in England, and our ton is almost universally two thousand pounds, although they still retain the traditional ton of twenty-two hundred and forty pounds in certain transactions; and as if to emphasize the utter absurdity of the thing, in some parts of New England a "long" or "gross" ton of coal weighs twenty-two hundred pounds. In many extensive calculations the avoirdupois pound is adopted as the only unit of weight, and fractional parts are expressed in tenths, hundredths, etc.; and this is found to reduce the labor of such calculations enormously. In length measure the tendency toward decimalization is still more marked. In land surveying and in engineering operations it is now the all but universal practice to use the foot as the unit and multiply and divide decimally.

In accurate machine-shop practice the use of decimal divisions is becoming almost universal. The unit is generally the inch, and it is subdivided into tenths, hundredths, thousandths, etc. "True to one hundredth, or one thousandth, or one ten-thousandth of an inch" is heard a hundred times oftener in every shop than "correct within a sixty-fourth or a hundred and twenty-eighth," etc., and it means not only greater convenience of expression and measurement, but an actually higher standard in precision of workmanship. To the objection, then, that the tendency of mankind is toward a binary rather than a decimal division of units, which is almost the only one offered by Mr. Spencer worthy of serious consideration, we may briefly reply by saying that even granting it to be a fact, it has no bearing whatever on the questions of ratios and relations of units, which is what distinguishes one system from another; that such a tendency may find expression in one system as well as another, and certainly with infinitely greater facility in the metric system than that now in use among English-speaking people; and, furthermore, that the estimation of fractional parts by tenths or hundredths is believed by many who habitually work that way to be both easier and more accurate than by halves, quarters, eighths, etc., and as a matter of fact the prevailing tendency is away from the latter and toward the former.

Mr. Spencer resorts to quotation, and brief reference should be made to the arguments set up by some of his authorities. The letter of Sir Frederick Bramwell contains some remarkable statements. His assertion that the new system will require "more figures to perform ordinary sums than on our present system, when rightly applied," is so grossly incorrect, as may be easily proved by a few examples, that no time need be spent in controverting it. The same might be said of his further assertion that it is more likely to lead to error, and, above all, to the common error in placing the decimal point. This last statement is frequently made, and it is worth while, therefore, to call attention to the fact that in all ordinary business transactions in which the decimal system is used, and in all calculations for that matter, the error of a misplaced decimal point is one of the rarest of all errors. This is because of the generally quick and certain detection of such a mistake. To misplace the decimal point by the smallest possible amount is to change the result tenfold, and usually so great an error is instantly detected by means of approximate knowledge or other checks. Take the United States' own money system, for example: it is perfectly safe to say that other mistakes are a million times more frequent than a persistent, undetected misplacing of the decimal point. Yet, curiously enough, considerable weight has been given to this

*Extracts from a paper by Prof. T. C. Mendenhall, President Worcester Polytechnic Institute, in Appleton's Popular Science Monthly.

objection to the metric system of weights and measures, which is, on the contrary, vastly less liable to errors of computation than that now in use. Sir Frederick also furnishes an extensive extract, giving the views of the first Napoleon on the subject of reform in weights and measures. Many of the stock arguments are repeated, and if they had not been thrashed over long ago it would be perfectly easy to take them up one by one and show their absurdity. An entire lack of any really accurate knowledge of the subject and an absence of any sort of conception of the simplest metrological principles are shown in a single quotation: "A toise, a foot, an inch, a line, a point, are fixed portions of extensions, which the imagination conceives independent of their relations one to another; if, then, we ask for the third of an inch, the mind goes into instant operation. The length called an inch is divided into three parts. By the new system, on the contrary, the mind has not to divide an inch into thirds, but a metre into a hundred and eleven parts." It is difficult to properly characterize such utter nonsense; but, fortunately, the French people, who are to-day the leaders in the world's metrology, were not obliged to take their science, as they were most other things, from the first consul. A group of the most distinguished Frenchmen of any period had perfected this system, even in the very midst of the bloody revolution which closed the last century, and when their final report was made in an address to the legislative chambers by the celebrated La Place, the event was described by Adams as a "spectacle at once so rare and so sublime . . . that not to pause for a moment, were it even from occupations not essentially connected with it, to enjoy the contemplation of a scene so honorable to the character and capacities of our species, would argue a want of sensibility to appreciate its worth. This scene formed an epoch in the history of man. It was an example and an admonition to the legislators of every nation and of all after times."

Mr. Spencer also quotes from an auditor who had to go over £20,000 of accounts, and who was "very thankful that it was not in francs." At first blush it seems entirely natural and creditable to him as an Englishman to rejoice that his twenty thousand is in pounds sterling rather than francs; but, after all, his remark is only a reflection of that not uncommon English sentiment that the imperial monetary system is more perfect than any other in the wide world. This sentiment is doubtless the outgrowth of national pride and intellectual inactivity; it is not entertained by the majority of the more thoughtful and scholarly Englishmen, and, furthermore, it is in every respect false. It is unnecessary to consume time in quoting the opinion of England's most distinguished scholars, to show this.

I must be content to stop without reference to a few other points raised by Mr. Spencer, for they are essentially all of a kind. There is a sentiment underlying much of his argument, to which I must briefly refer, however, because it has shown itself in other recent discussions of this subject. I refer to an anxiety lest the "poor man" be in some way injured by the proposed reform. It has come to be the fashion in all political or economical controversies to exhibit a consuming interest in the poor man's welfare; indeed one marvels that there should continue to be any poor, so universal and so intense appears to be this anxiety to shield them from all harm. Fortunately, the so-called "poor man" is not so blind to his own interests as some would have it appear, and he is quite alive to the fact that the proposed metrological reform is fully as important to him as to anybody.

Finally, it ought to be understood that the advocates of the metric system do not assume that it can come into use immediately or without considerable hardship. It took nearly a century to fairly establish the decimal money system in the United States, which no one would now think of giving up. During all this time old units and denominations continued to be used in a lessening degree, although not authorized by law. Something of the kind must occur in the transfer from our illogical, brain destroying, time-consuming system of weights and measures for the more perfect system for which it is sure to make way. Furthermore, they heartily welcome and desire the presentation of all arguments against or objections to the metric system, believing that the more widely it is known and discussed the more supporters it will have. They expect to meet occasionally such "intelligent prejudice" as is exhibited by Mr. Herbert Spencer, whose contribution to the discussion of the subject is sure to be considered in the years to come as altogether the most remarkable to be found in any time or tongue.

THE PRACTICAL MAN.

Weights of square and round bars of wrought iron in pounds per lineal foot.—Kent.

Iron weighing 480 lbs. per cubic foot. For steel add 2 per cent.

Thickness or Diameter in Inches.	Weight of Square Bar One Foot Long.	Weight of Round Bar One Foot Long.	Thickness or Diameter in Inches.	Weight of Square Bar One Foot Long.	Weight of Round Bar One Foot Long.
0			4	53.33	41.89
1-16	.013	.010	1-16	55.01	43.21
1-8	.052	.041	1-8	56.72	44.55
3-16	.117	.092	3-16	58.45	45.91
1-4	.208	.164	1-4	60.21	47.29
5-16	.326	.256	5-16	61.99	48.69
3-8	.469	.368	3-8	63.80	50.11
7-16	.638	.501	7-16	65.64	51.55
1-2	.833	.654	1-2	67.50	53.01
9-16	1.055	.828	9-16	69.39	54.50
5-8	1.302	1.023	5-8	71.30	56.00
11-16	1.576	1.237	11-16	73.24	57.52
3-4	1.875	1.473	3-4	75.21	59.07
13-16	2.201	1.728	13-16	77.20	60.63
7-8	2.552	2.004	7-8	79.22	62.22
15-16	2.930	2.301	15-16	81.26	63.82
1	3.333	2.618	5	83.33	65.45
1-16	3.763	2.955	1-16	85.43	67.10
1-8	4.219	3.313	1-8	87.55	68.76
3-16	4.701	3.692	3-16	89.70	70.45
1-4	5.208	4.091	1-4	91.88	72.16
5-16	5.742	4.510	5-16	94.08	73.89
3-8	6.302	4.950	3-8	96.30	75.64
7-16	6.888	5.410	7-16	98.55	77.40
1-2	7.500	5.890	1-2	100.8	79.19
9-16	8.138	6.392	9-16	103.1	81.00
5-8	8.802	6.913	5-8	105.5	82.83
11-16	9.492	7.455	11-16	107.8	84.69
3-4	10.21	8.018	3-4	110.2	86.56
13-16	10.95	8.601	13-16	112.6	88.45
7-8	11.72	9.204	7-8	115.1	90.36
15-16	12.51	9.828	15-16	117.5	92.29
2	13.33	10.47	6	120.0	94.25
1-16	14.18	11.14	1-8	125.1	98.22
1-8	15.05	11.82	1-4	130.2	102.3
3-16	15.95	12.53	3-8	135.5	106.4
1-4	16.88	13.25	1-2	140.8	110.6
5-16	17.83	14.00	5-8	146.3	114.9
3-8	18.80	14.77	3-4	151.9	119.3
7-16	19.80	15.55	7-8	157.6	123.7
1-2	20.83	16.36	7	163.3	128.3
9-16	21.89	17.19	1-8	169.2	132.9
5-8	22.97	18.04	1-4	175.2	137.6
11-16	24.08	18.91	3-8	181.3	142.4
3-4	25.21	19.80	1-2	187.5	147.3
13-16	26.37	20.71	5-8	193.8	152.2
7-8	27.55	21.64	3-4	200.2	157.2
15-16	28.76	22.59	7-8	206.7	162.4
3	30.00	23.56	8	213.3	167.6
1-16	31.20	24.55	1-4	226.0	178.2
1-8	32.55	25.57	1-2	240.8	189.2
3-16	33.87	26.60	3-4	255.2	200.4
1-4	35.21	27.65	9	270.0	212.1
5-16	36.58	28.73	1-4	285.2	224.0
3-8	37.97	29.82	1-2	300.8	236.3
7-16	39.39	30.94	3-4	316.9	248.9
1-2	40.83	32.07	10	333.3	261.8
9-16	42.30	33.23	1-4	350.2	275.1
5-8	43.80	34.40	1-2	367.5	288.6
11-16	45.33	35.60	3-4	385.2	302.5
3-4	46.88	36.82	11	403.3	316.8
13-16	48.45	38.05	1-4	421.9	331.3
7-8	50.05	39.31	1-2	440.8	346.2
15-16	51.68	40.59	3-4	460.2	361.4
			12	480.	377

To compute the weight of sheet steel—Divide the thickness, expressed in thousandths by 25; the result is the weight, in pounds, per square foot.

For weight of sheet brass, add 11 per cent.

For weight of sheet copper, add 10 per cent.

THE WATER CURTAIN.

For many years the water curtain has been in use in Canada as a means for fire protection. Some years ago when a building next door to the T. Eaton Co., Toronto, was burned down the value of this device was most apparent, since unshuttered windows within a few feet of the flames were not even cracked by the intense heat, because of the sheet of water which fell from the roof and from the tops of the windows where perforated pipes had been arranged for the purpose. That this is looked upon as a great novelty is evidenced from the following paragraph, quoted from a recent issue of The Engineering News, New York:

"Another form of protection against exposure fires which has recently been employed is the outside fire sprinkler system. This has been applied on an elaborate scale to the costly new public library building for the city of Chicago. As many of our readers doubtless recall, water curtains have been frequently suggested as a means of fire protection, but this is, we believe, the first instance, in America at least, in which such a device has actually been constructed."

GREEN'S ECONOMIZER.

Editor CANADIAN ENGINEER:

Referring to the article in your June issue, entitled "A Dismissed Engineer," it would appear that the utility of the economizer was not what it was guaranteed to be to the city of Toronto. The question of the utility of the economizer to the city of Toronto, and of the sufficiency of the tests made, is to be thoroughly sifted in an action brought by us, and now pending, and we are fully prepared to show when the proper time comes that the economizer has done everything that it was warranted to do. We consider it a little unfair on the part of your paper in the meantime to publish extracts from Judge MacDougall's report, which is based upon an investigation entirely ex parte as far as our company is concerned.

THE GREEN FUEL ECONOMIZER CO.

Matteawan, N.Y., August 15th, 1899.

NEW CATALOGUES.

Cranes—The Northern Engineering Works, of Detroit, Mich., U.S.A., have sent out their first catalogue, consisting of twenty pages, which illustrate three motor electric travelling cranes, compressed air travelling cranes, portable pendant winch, hand chains, jib cranes of the cantilever and single braced types, air hoists. Tumblers of different styles suitable for foundry use are also shown. It is sent free to enquirers. G. A. True is general manager; the engineer is Ed. S. Reid, late of the Whiting Foundry Equipment Co., Chicago.

The Gutta Percha Co.'s pocket catalogue for 1899-1900 to hand, and it illustrates the various styles of rubber footwear made by this well-known concern, under their famous trade mark, "Maltese Cross." Almost every conceivable style of footwear is shown from children's rubbers to lumbermen's, sporting and firemen's gum boots.

SEPTIC TANK SYSTEM OF SEWAGE TREATMENT.

A great deal of interest is being taken in Ontario in the Septic tank system of sewage treatment. C. H. Rust, C.E., city engineer of Toronto, has recommended the Septic tank system for adoption in that city. The following description of two plants on this system now in operation in the United States is taken from a recent issue of The Engineering News, New York:

The largest Septic tank for the treatment of sewage thus far built in the United States is located at Verona, N.J., seven or eight miles from Newark. It receives the sewage of a branch of the Essex County Lunatic Asylum, and was designed and built by Jas. Owen, M. Am. Soc. C.E. The tank and supplementary filter beds were put in operation about November, 1898, and now receive the sewage from a large building containing some 300 patients and attendants. Quite a large roof area is connected with the sewerage system, the connection having been made before it was decided to treat the sewage. The amount of sewage treated daily is placed by Mr. Owen at 40,000 gallons. The tank is of concrete, and is 18 x 50 ft. by 10 ft. deep, giving a capacity of about 65,000 gallons. It has a trapped inlet, from a small grit chamber 4 feet square. There is a man-hole at about the center of the top of the concrete roof of the tank, but the cover of this is sealed up with cement. The tank effluent passes out through a 16-inch pipe, beneath the surface on to four filter beds. Each bed is 14 feet square, with concrete walls and bottom. At the intersection of the division walls of the bed is a sheet iron distributing pan, 3 to 4 feet in diameter, with a bottom curved upwards, and a notch in one side to allow the sewage to flow on to the bed. The pan was provided with a device designed to cause it to revolve automatically through one-fourth of its circumference whenever the bed receiving sewage became filled, but the device has not proved successful, and the pan is now revolved by hand. The filtering material was originally composed of sand at the top, then coke, then gravel, resting on a layer of large-sized stone, making a total depth of about 5 feet. This choked up in about three months' of operation, which was in winter weather, making it difficult to do any cleaning. All the material, except the large stone, has been replaced by 3½ feet of coke, with 6 inches of coarse sand at the top. The walls of the bed extend about 16 inches above the top of the sand. The tank has not been cleaned since it was put in use. The amount of sludge which has accumulated is unknown, as the tank is sealed. To the eye the tank effluent, as it flows over the distributing pan, has a cloudy or slightly milky appearance, but it seems to be pretty free from suspended matters. On the bed, however, a depth of 0 to 12 inches has a brownish or yellowish look, like water standing in a muddy pool. A silver coin, held between the thumb and finger, could scarcely be distinguished at a depth of 5 or 6 inches. The tank effluent flowing from the pipe or dipped up in the hand from over the bed, had a strong sewage smell. One of the filter beds, which was in need of being raked, showed a thin skin of dark, almost black, sludge, which had curled up in small patches, on partially drying out. This, too, had a strong sewage smell. The effluent from the filter beds is discharged into a ditch leading into a small stream. This effluent at a point where it issued from the beds also had a pretty strong odor, less decided than that directly from the tank. As the four beds have a combined area of only 784 square feet, they work at an average rate of more than 2,000,000 gallons per acre, per day, assuming a total daily flow of 40,000 gallons. This is very high. With the present relation between daily flow and tank capacity the sewage remains in the tank about 40 hours, assuming proper distribution through the tank, and making no allowance for sludge accumulation. Perhaps a shorter stay in the tank or a more thorough aeration, or both, would enable the filter beds to do better work. As it is now, there is reason to believe that the sewage reaches the beds in such a state that little or no nitrification could be expected, except at a very low rate of filtration. It is realized that the beds are overworked, and a supplementary filtering area is proposed. The present plant cost about $2,600.

In March, 1898, after careful study into the more recent English method of bacterial purification of sewage had been made for the city of Columbus, Ohio, and their trial then recommended, beginning on a small scale, an opportunity was afforded Alvard & Shields, engineers, Chicago, to install a plant of this character for a large Golf and Polo Club house near Chicago. The soil of this vicinity being a very heavy clay, was not adapted to intermittent subsoil irrigation, which had already been ineffectually tried, and the expense of procuring sand, which had to be hauled from a great distance, debarred the consideration of artificial sand filters to any considerable extent. No dilution was afforded for the effluent, as the stream which passed through the grounds became entirely dry during the entire season when sewage purification would be needed. The only available location was necessarily within full view of the club house, and within 100 feet of a teeing ground; so that it was important that the method adopted should be such as to enable the plant to be concealed from view.

Under these circumstances, nitrification on prepared coke beds was decided upon, and a first installation based upon a sewage flow of 2,000 gallons per day was installed in a little more than two weeks. The plant consisted of a large flushing tank, with a capacity of 850 gallons, into which the sewage from the main building discharged; a basket screen of wire of 1 inch mesh removing the large matters such as waste paper, rags,

lemon and orange peel and the like. After leaving this tank, the sewage, somewhat staled, was discharged periodically upon a single nitrification bed, in a brick chamber 12 feet in diameter, and 3 feet in depth, filled with coke, the particles of which were of chestnut size and smaller. Perforated drains led from beneath this bed to an automatically-controlled valve in a man-hole outside of the chamber, so arranged and operated by means of differentiated inlets and a float as to discharge the contents of the bed after it had remained in contact with the coke some 2½ hours. The effluent from the coke bed thence passed on to an artificial sand filter, 30 inches deep, carefully prepared of graded and suitable materials and well underdrained, and proportioned for a rate of flow of 250,000 gallons per acre per day. The object of this room arrangement was, that such an anaerobic action as might be possible would be set at work in the flush tank, which was made large for this reason; and that the partially broken-down organic matter would be the more readily acted upon in the nitrification bed. Subsequent experience led us to highly value this feature of the design and extend it. The sand filter was only added as a precautionary measure. The sewage from the very first was of high concentration owing to the insufficiency of the water supply—rough determinations showing free ammonia, 3.40 parts per 100,000; albumoid ammonia, 0.75; chlorine, 8.00. Notwithstanding this, bacterial activity was rapidly set up in the nitrification bed, and in two weeks was at its best, the effluent being bright and odorless, the sand filters evidently having little if any work to do. This condition was maintained all during the early part of the season. Among the minor practical difficulties which developed was the fact that the sewage would form a membrane over the top of the coke bed. No attention whatever was given to the plant by the attendant of the club, and if neglected for many weeks, this membrane would become water-tight. When this film was broken open the sewage would rush down violently into the coke bed, showing that it was filled with air beneath. So long as the sewage could be got to go down into the coke, it would purify itself readily; and during the entire summer no deposit was to be found at the bottom of the bed—a difficulty which had been feared at the outset. During the summer the particles of coke each became covered over with a thin film of nitrogenous matter, slightly reducing the liquid capacity of the bed; but evidently increasing bacterial activity. It is estimated that with the average flow of sewage for the summer, not less than 440 cubic yards of sludge of 90 per cent. moisture were entirely consumed in this little space of 340 cubic feet. The purification effected in the early work of the plant was over 95 per cent. of organic matter removed.

In the early part of September when some 4,000 gallons of very concentrated sewage were being purified daily, the bacterial efficiency of both coke and sand bed failed; and the results which followed brought into more prominent light its recent excellent efficiency. Where golfers had frequently passed over it and by it in scores every day without observing its proximity it became so odorous as to make its presence known for several hundred feet around. Steps were promptly taken to temporarily divert the sewage, and the filter was given a rest for about a week. The area of the secondary sand filter was slightly increased, and a new form of filling and emptying device for the coke bed was introduced; the original one having proved unreliable through corrosion. Otherwise no change was made in the plant, the coke not even being removed from its bed. At the end of the week it was in good condition, and sewage was again introduced in gradually increasing quantities. It was noticeable that the coke freed itself from impurities much more rapidly than the sand filter. The results of the season's experience having met the most sanguine expectations of the builders it was determined to increase the capacity of the plant, both to reduce the rate of flow and to meet new demands upon it from an additional building erected in the spring of this year. Accordingly it was remodelled entirely and enlarged so as to be fully capable of purifying 6,000 gallons per day. The new plant consisted of a septic tank capable of holding the maximum flow of 24 hours, built of brick, arched and sodded over. The original flush tank was dispensed with, and the sewage passed direct to the septic tank without intervening screen or grit chamber. The effluent from the septic tank passed to two square nitrification beds by means of an alternating device which has now worked successfully for six months. The nitrification beds were of brick, 12 feet square with an effective depth of three feet. One was filled with the coke used the previous year, which was found when removed from its old bed to be as clean and bright as when it had been deposited there the year before. The other bed was filled with fine cinder about pea size. The rate of flow through the nitrification beds was (intermittently) 500,000 gallons per acre per day, or about 2 cubic feet of coke to 1 cubic foot of sewage per day. The alternating device is so regulated that the beds fill in from five to six hours when running at the maximum rate. The beds have seemed to become effective after a film of nitrogenous matter forms upon the particles of coke. The effluent automatically and alternately discharged on to the sand bed used last year, which, however was not enlarged at the time the plant was remodelled. The new design seemed to be fully equal to the occasion, and most effective purification resulted even without the use of the sand bed.

A rather curious and singular disaster, however, befell it, which caused much trouble and no little study for the time being. After having operated many weeks in a most satisfactory manner it suddenly began to fall. The most noticable failure occurred in the effluent from the septic tank, which became opalescent, and the sewage in the nitrification beds rapidly filled with a large amount of black sooty filaments, denoting decomposition. It was evident that something was wrong, but for the moment just what could not be determined. A little later there began to appear on the surface of the nitrification beds a lime sludge, which ran over from the septic tanks. Investigation showed that this was nothing less than the calcium carbide ash from a large acetylene gas plant which has recently been installed, and which used 100 lbs. of carbide daily, the saturated residue of which had been daily deposited in the main sewer. It was the most convenient way for the attendant of the acetylene plant to get rid of his own troubles, but it made several weeks of exceeding trouble for others. The ash from the calcium carbide in such quantities has enough lime to completely destroy bacterial activity in the septic tank or nitrification bed, to say nothing of its being a material which is most disastrous to sewers themselves by choking and filling them with its deposit.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Annual Dinner of Toronto No. 1.

The 13th annual dinner of Toronto No. 1 branch of the above association was held at Webb's restaurant on Thanksgiving eve, and was the most successful reunion yet held. The tables in the main hall were filled and an "overflow" table in the adjoining room well taken up, about 150 guests being present. The dinner was served in Harry Webb's best style, and was much enjoyed by all.

The chair was occupied by the president, Herbert Terry, and on his right sat Mayor Shaw, Ald. Hallam and Ald. R. C. Pettigrew of Hamilton, representing the Hamilton branch of the C.A.S.E. On the chairman's left sat A. M. Wickens and Ald. Frame. After welcoming the guests and mentioning the fact that of all the members of this association in Toronto only two were without full employment at the present time, the toast of the "Queen" was proposed and received with enthusiasm. John Alexander sang "Stand by the Old Flag," which was loudly cheered. The toast of "Canada Our Home" was coupled with the name of Ald. Hallam, who was warmly received. In responding he said that as an adopted son of Canada he always felt it impossible to do justice to the varied charms and the vast resources of this immense country, and he could only say that he loved it. There was no man who came to this Dominion willing to work that could not make a living and save something over. Thousands who came here poor are now wealthy. A country larger than the United States and only 300,000 square miles less than the whole of Europe had great possibilities. It was a land celebrated alike for its liberty and its loyalty to the Old Land (cheers), and he was glad that in the present South African crisis Canadians were ready to stand for the integrity of the Empire. We all revolted at the conduct of the Turks to the Armenians, but the conduct of the Boers towards the Uitlanders in the Transvaal was of the same tyrannical nature. The Boers were, in fact, the Turks of South Africa. He was glad to tell them that the city council had declared a half holiday on the occasion of the departure of the South African contingent, and

he hoped they would all turn out with flags. Referring to personal matters he felt justified in speaking of his long services in the city council, and to what he had done for the public library, and it was no secret that he would be a candidate for the mayor's chair for 1900. (Voices—"We'll elect you.") He was glad to feel that he had the support of so many of those present, and he should do all in his power to promote the prosperity of the city. Geo. W. Grant and John Alexander sang the duet, "The Standard on the Braes of Mar," and were enthusiastically encored. "Toronto Our City" was coupled with the names of Mayor Shaw and Ald. Frame, who were well received, and in their remarks referred to the great advantages and bright prospects of the Queen City. Wm. Prestwick then sang a comic song and received an encore. "The Manufacturers" was replied to by G. R. Baker, of Westman & Baker, who was glad to see so bright a silver lining to the cloud that had hung over manufacturers for some years. The good times were well indicated by the price of pig iron, which had gone up from $12 a ton to $24, and was likely to go up to $30. Steel was also up in proportion, and when these materials rose it was a barometer showing expanding trade. He was glad that this association was not a labor organization, and took no part as a body in strikes and agitations, but aimed only to improve the minds of its members. This was a hopeful sign. There was no trade in which there were so many botches as in the machinists' and mechanical trades. Speaking of the need of technical education, he was surprised how few men could read a mechanical drawing, and the technical school here should have its work extended. He hoped the machinists and mechanics would take pattern by the stationary engineers in the matter of study for self improvement, for he held that every mechanic ought to have an ambition above the bench. J. D. Powers then sang "Brown October Ale," and was recalled. John Mayne was also called on and said trade in his line was remarkably good, and he did not know a boiler maker in Canada who was out of a job. Competition, however, was still keen, but he was proud to say that Canada was now competing with the greatest countries in the world in the production of machinery and other manufactures. Many members of the C.A.S.E. had become convinced of the value of the association, as some of them would not now be in the positions they occupy had it not been for the connection. The engineer was now getting to be a man of responsibility and influence, and many a manufacturer looks to him for advice on questions of coal consumption, electricity, gas, compressed air and kindred questions. Ald. Hallam here said he might remind the members that the city council had not lost sight of the technical school matter, but had already voted $75,000, but he wanted $25,000 more for the extension of the work. The site for the new school had already been secured, and as soon as this additional grant is made the work could go ahead. The matter was now in the hands of Ald. Lamb, whom the members should stir up. He (Ald. Hallam) had done all he could to promote this work, which he felt had already borne fruit, as he knew an instance where a young man who got the rudiments of his training at this school was now filling an important place in New York at a salary of $5,000. Mr. Gray then gave a trombone solo which was well rendered. A telegram was then read from City Engineer Rust regretting that absence from the city prevented his being at the dinner, but wishing them a pleasant time. The toast of "The Executive" was responded to by Robt C. Pettigrew, of Hamilton, the executive president, who said he was proud to have the honor of the presidency of this association, for he looked upon it as the greatest organization in existence. It was great because it was educational, and because its objects were solely the intellectual and technical improvement of its members. Bro. Wickens, the secretary, was preparing question papers to be sent out quarterly and this will do much to help the associations in rural districts. Alluding to the progress of his city he humorously referred to Toronto as the northern suburbs of Greater Hamilton. He closed by commending the work of the Toronto Technical School. Mr. Alexander then sang "Kings of the Road." Bro. Geo. C. Mooring, executive vice president, followed, explaining briefly the relations of the general executive to the different branches and said the Toronto branches were more flourishing than at any time in the history of the association, and its finances as well as membership were in better shape than ever. He urged the need of legislation, which would put the stationary engineer upon as good a footing as the marine engineer, and hoped something would be done at the next meeting of the Ontario Legislature. Bro. Charles Moseley, treasurer, also spoke, saying that all members interested would find in the September number of The Canadian Engineer the draft of the law which it was proposed to submit to the Legislature. There was some prejudice yet to overcome, but all could do something to remove this from the minds of members of Parliament. The association was prospering, new branches were being formed, and it was only a matter of time till our legislators would fall into line. There was now a permissive law in Ontario under which certificates of qualification were issued, but this did not fill the bill. There were numbers of second-hand steam plants in operation in this province, and there should be some sort of inspection enforced, which would prevent the use of such dangerous engines and boilers. Mr. Prestwick sang a comic song, "Old Clo'," which was encored. "The Sister Societies" was replied to by Robt. Mackie, of Hamilton branch, and Alex. McRae, of Toronto No. 2, who spoke briefly and to the point. The latter, speaking of the need of some standard of qualification for the steam engineer, mentioned a case where a boiler was taken out of an old tug, after being condemned, and sold to a man who erected it in a saw-mill. If this boiler was condemned in a tug, where it might have endangered the lives of three or four men, why should it not be condemned in a saw-mill, where it would endanger the lives of thirty or forty men? After a song by Messrs. Grant and Alexander, Bro. Pettigrew proposed "Toronto No. 1," coupling it with the names of Bros. Terry, Wickens and Huggett. The first named gentleman relegated his speech to Bro. Wickens, who expressed his strong desire to see the cause of technical education advanced more rapidly in Toronto. No business required to advance more rapidly than the engineering and mechanical trades. If a man embarking in some new line of manufacturing wanted some appliance never used before for a certain purpose it was to the mechanical man he would go to get the idea put into practice. A man who could work out practical ideas was worth something to his employer, and the more he improved the more valuable he became. There was nothing visionary in the value of technical knowledge. He saw young men before him who were living evidences of the advantages of study on practical lines, and especially of membership in this association. He believed in the idea of mutual help. There was no use in a man hiding his light under a bushel—in fact the man who did so generally had not much light to hide. As to legislation there was no reason why a stationary engineer should not be licensed. If it was necessary to license a marine engineer, who might have half a dozen lives in his care for four or five months in the year, it was surely necessary to license a stationary engineer who might have as many hundred lives in his hands the whole year round. It might be laid down as an axiom that there was no such thing as the explosion of a boiler by accident, so that skill in the handling of boilers and engines was all important. Bro. Huggett followed on the same lines, and in regard to the Technical School question claimed that the association ought to have a more direct and larger representation on the board than it was proposed to give. After the press had been responded to by representatives of The Canadian Engineer and Canadian Electrical News the gathering broke up about 1 a.m.

HAMILTON BRANCH, C.A.S.E.

A meeting of the Hamilton branch of the Canadian Association of Stationary Engineers was held October 17th, in their hall. The attendance was fairly large. The meeting marked the commencement of an educational movement in connection with the society, to extend throughout the fall and winter, and to consist of a series of papers on educational topics of particular value to the membership of the association. Among other subjects treated will be mathematics, mechanics, engineering and electricity. A paper, the first of a number on mathematics to be given by C. R. T. Fessenden, of the Westinghouse Co., dealt exhaustively with the subject of fractions. In the beginning it was emphasized that it was important that all engineers and mechanics should have a thorough knowledge of this subject, as the character of their work frequently required the use of difficult fractions. By blackboard examples he explained and illustrated the principles and use of fractions, from the elementary common fraction to problems in decimals, and gave a num-

ber of valuable rules on short methods, and the avoiding of complications in working them out. After the conclusion of the paper Mr. Fessenden satisfactorily answered and explained a number of questions on the obtaining of areas of circles, and the reduction of inches to decimals. It was announced that his next paper would probably deal with mensuration and formulas for obtaining square and cube root. On a motion by R. C. Pettigrew and George Mackie, a vote of thanks was tendered Mr. Fessenden for his paper. Mr. Pettigrew said that it was the intention of the provincial executive of the association to publish and distribute circulars containing questions on educational topics of particular interest to engineers and mechanics, and that the taking up and answering of such questions would be a prominent feature in the educational movement in connection with the local branch.

On Oct. 19th at 10.30 the C.A.S.E. and O.A.S.E. executive held a special joint meeting in the C.A.S.E. hall, Toronto. The arranging for some minor changes in the details of the clauses referring to inspectors in the draft of proposed bill (draft given in the September number of The Canadian Engineer), and also the advisability of engaging proper legal counsel to represent them before the committees who would act in harmony with the solicitor of the O.A.S.A., was discussed. It was decided to issue a circular to the subordinate associations containing a request for funds sufficient to put legislation through properly, and it was decided that the circular would also have embodied in its contents the question of a plebiscite to ascertain the wishes of the C.A.S.E. members as to whether an annual or biennial convention would be held in future. Full report of the discussion was given in our September number regarding this matter, and this is the vote decided at that time to be taken. The C.A.S.E. executive present were: President Pettigrew. Chas. Moseley, treasurer; A. C. Mooring, vice-president; John M. Dixon, Robt. Mackie, A. M. Wickens, W. Wadge and Thos. Elliott were the representatives of the O.A.S.E.

THE REED MANUFACTURING CO., ERIE, PA.

In our advertising columns our readers will find an illustration of a new malleable iron pipe vise with tool steel sectional jaws. This pipe vise is a radical departure from the old style so familiar to all plumbers and engineers, and has the maker's guarantee that one will outwear four of any solid jaw pipe vise. Another article which to engineers is of very great interest is the Economy automatic eccentric, cross-head and wrist pin oil cup for marine, traction, and stationary engines. This cup has now been on the market six years, and it is claimed that no device attached to the rotating and oscillating part of an engine can compare with the Economy in perfect lubrication and saving of oil. It is to the crank pin, the cross-head, the eccentric, and in fact to any part of the engine where there is sufficient motion to throw the oil from the bottom to the top of the cup, as the automatic sight feed lubricator is to the cylinder over the old common suction cup. Many of the large shops and factories are using these cups exclusively; the Carnegie Company having nearly five hundred in use, and the L.S. & M.S.R.R. Company have used about one thousand. Its makers state that with the old type of cup more oil is wasted during the fourteen hours the engine is idle than is used while it is running. As the Economy cup feeds only while the engine is in motion, and the oil is sprayed from the top of the cup in minute particles, it absolutely prevents any waste while the engine is idle. It is a well known fact that the least bit of good oil will keep a smooth pin cool. The trouble with all other cups is to supply sufficiently small quantity of oil to do the work and feel secure that the cup will continue to feed. With the Economy you need not set the feed, only to remove the feed cap and replace it with another of a larger or smaller feed hole as the case may require. This can be done at any time in half a minute, without the use of any tools. After the proper feed is once ascertained it will never change; the oscillating motion puts the oil into openings, and air compression completes the operation. Long-continued use does not affect its reliability. A guarantee to save 50 per cent in oil is given with each cup by the makers. The construction is claimed most perfect and simple.

The Clark pipe hanger is another noticeable product of the Reed Mnfg. Co., and is said to be the cheapest as well as the best of all pipe hangers. They are designed for use on steam water, gas and soil piping, are made of high grade malleable iron, and they are unbreakable. Piping can be hung closer to ceiling than with any other hanger it is claimed, and adjustment to any required length can be had by means of a hanger bolt, piece of pipe and coupling. It can be put up or taken down in an instant, the hanger bolt being put up first and hanger clasped over it. Hanger bolts are furnished with hanger unless otherwise ordered. The Clark adjustable beam hanger is another type also made. The Reed Manufacturing Company, Erie, Pa., will send circulars fully illustrating and describing these goods, on application.

DISCRIMINATION IN CARBON DUTIES.

Editor CANADIAN ENGINEER :

We are in receipt of your letter of the 28th, and in reply beg to state that the situation is briefly this: We have been selling our 7-16 by 12-inch carbons of second quality at approximately $5 per thousand, ½ by 12-inch at $6, f.o.b., Cleveland. The duty on our goods was formerly based on face of invoice, but since the last revision in the tariff the valuation was increased to an average price of $8 per thousand for 7-16 inch regardless of billing price, and either $8.50 or $9 for the ½-inch size. The duty was also advanced from 25 per cent. to 35 per cent., based on the new valuation. The same carbons are sold in this country at same prices as we have first mentioned, and in some cases even a little less where large quantities are ordered, but as a matter of fact, there are less of the second grade carbons used in this country than in Canada, for the reason that the American consumer has no duty to contend with, consequently his carbon cost does not run up and he can, therefore, use the first grade carbon rather than to put up with a little trouble in trying to use second grade carbons. In Canada the tendency has been to use second grade carbons in order to keep down expenses. By the time our second grade carbons are landed in Canada, the duty and freight makes them cost even more than the American consumer pays for first grade carbons. This is the reason why nearly all of the Canadian trade has been accustomed to using second grade carbons. The Canadian customs are placing a valuation on these carbons on the basis of the selling prices of first grade carbons in this country. This is where the discrimination or unjustness of the revision comes in. Yours very truly,

NATIONAL CARBON CO.

ADVANTAGES OF COKE OVER COAL AS A FUEL FOR GENERATING STEAM.*

BY ARTHUR C. FREEMAN, WALTHAM, MASS.

The item of fuel being one of the large items of expense entering into the cost of manufacturing, is necessarily one in which every manufacturer is interested. The most important fuel in use at the present time is coal. The cases where wood is used are exceptional, and becoming more so as the population increases, and timber becomes scarce and more in demand for structural purposes. It is only recently that the question of coke has been seriously considered by manufacturers here in New England, although large quantities are annually consumed in the West, where it enters into competition with both hard and soft coals. One of the reasons why this fuel has not been more extensively used in New England is possibly due to the fact that it is only recently that its manufacture has been attempted on a commercial scale. The heretofore high cost has also been one of the reasons for its no more general adoption.

Coke, as generally understood, is carbonized coal or the carbon of the coal left in the ovens after expulsion of the volatile substances by heat; or, as it is generally called, *coking*. The volatile substances are tar, pitch, gas, ammonia, and smoke producers. About one third of the weight of the coal is thrown off in the coking process; the carbon in one and one-half tons of coal is therefore largely represented by the one ton of coke. The manufacture of coke is generally carried on in heaps, retorts, or ovens, and is spoken of as gas or oven

*A paper read before the Canadian Manufacturers' Association at the annual convention in Montreal.

coke, referring, of course, to its mode of production. In the case of oven coke, the object is not so much to prepare coke as it is to obtain gas, tar and various other products. In the present day, coal is converted into coke almost exclusively in ovens constructed for this purpose, it having been found that by the use of ovens the operation is more readily conducted, and that a larger quantity and better quality are obtained.

Coke is prepared for various purposes: For increasing, or rather concentrating the quantity of carbon in the coal, and thus obtain a fuel which will yield a more intense heat than coal. For the purpose of converting coal into a fuel which does not become pasty when ignited. Coal in consequence of this property being unsuitable for blast, cupola, or other furnaces. Well burnt coke, or oven coke, is a hard, uniform, compact, solid mass, difficult to break, and not honey-combed, or very porous. Its color is black-gray or iron-gray, with a dull, metallic gloss. Good coke should contain very little sulphur. When discharged from the ovens, coke consists chiefly of columnar pieces about eight inches long and four or five inches thick, with smaller pieces mixed in. By a specially designed crusher, it is then broken up into various sizes, as egg, nut and pea. For boilers it is generally used as it comes from the ovens. The advantages claimed for this fuel are that it is clean, there being no dust, no dirt, no smoke, and but few ashes. It kindles quickly, makes the hottest fires, is easily controlled, and requires but little draft. It does not clog the boiler flues, thus obviating the frequent and expensive cleaning. This secures the complete utilization of the heat value of the fuel. It is smokeless. When looking at the stack of a boiler fired by coke, it is impossible to determine whether the boiler is running or not. This absence of smoke, especially around bleacheries and other places where expensive and fine work is carried on, and in thickly populated communities, where soot and smoke are so destructive, is a matter of no little importance.

Its general use would probably do away entirely with the smoke nuisance encountered in some of our large cities, and would add immeasurably to the comfort of those who travel by steam where coal is used. At the present time this question of smoke from soft coal is receiving the very serious consideration of the municipalities of some of our large eastern cities. New York is seriously threatened with the same affliction that has beset Pittsburg and Cincinnati, and Boston is fast losing its prestige as a clean and healthful city. Fine buildings are being injured by smoke, and what is far worse trying to the individual, the interior of houses likewise suffer from the same cause. From a hygienic standpoint the health of citizens must in a measure be impaired by breathing in this soot. With the volatile substances removed, the dangers from spontaneous combustion are entirely eliminated; and it can be kept with safety anywhere, and for any length of time. Coke is a fuel unlike bituminous coal in its composition, and therefore requires somewhat different treatment when used in place of that fuel. It resembles hard coal, and should be fired in a somewhat similar manner. Some changes in the ordinary grates will probably be necessary to burn coke with maximum economy and convenience, but it can be burned on ordinary grates. The following suggestions will be found useful in learning its management:

1st. In building the fire, put the coke on lightly and often, until the fire is seven or eight inches thick. An eight-inch fire will make steam much better than a heavier one. 2nd. It is better not to disturb the top of a coke fire, therefore when firing, spread the fuel evenly, to keep the fire level. 3rd Shaking bars are very suitable for burning coke, and they should be shaken frequently. If dead bars are used, a light poker should be run under the fire frequently to keep clinkers from clinging to the grate and to keep them broken up. A poker is better than a slice bar for this purpose, as it is lighter and more easily handled. The object is not to bar up the fire, but to detach small pieces of clinker, and prevent them from forming and running together. 4th. It is advisable to keep water in the ash pit or to introduce a jet of steam.

Following is the result of a test made by the Mutual Boiler Insurance Co., of Boston, on the evaporative powers of coals and coke compared with the best soft coals. Steam making value is the only criterion used in making up the table below. The coke is that of the New England Gas and Coke Co., and the value is based on boiler tests and on proximate and ultimate analysis.

COMPARATIVE EVAPORATIVE POWERS OF COALS AND COKE COMPARED WITH THE BEST SOFT COALS.

Soft Coals.	Combustible.	Probable p.c. of Refuse	Coal as Bought.
Pocahontas	100	7½	100
Best Cumberland	100	7½	100
Average Cumberland	98	7½	98
New River	95	5	97
Clearfield	95	10	92
Pittsburg (Youghiogheny)	88	6	89
Ohio (Hocking Valley)	80	6	82
Nova Scotia	83	10	81
Anthracite steam coals and coke—			
Coke (New Eng. Gas & Coke Co)	91	9½	89
Lykens Valley Pea	96	15	88
Lykens Valley Buckwheat	96	18	85
Wyoming Pea	95	15	87
Wyoming Pea, Buckwheat	95	18	84
Schuylkill Pea	93	15	85
Schuylkill Pea, Buckwheat	93	18	82
Lehigh Pea	91	15	84
Lehigh Pea, Buckwheat	91	18	81

The boiler tests are full length tests carefully made on the type of boilers in general use, and with grates suitable for the coke. They indicate a value for the combustible portion of 86 per cent., both when considering the evaporation alone, and when allowance was made for the information given by gas analysis. The proximate analysis indicated a value of 92 per cent. and the ultimate analysis indicated a value of 93 per cent., from which figures we have estimated that 91 per cent. was a fair estimate for the evaporative power of the combustible. The percentage of refuse averaged 9½ per cent. in three boiler tests. Another boiler test showed over 20 per cent. due to unsuitable grates for the size of coke used; but 9½ per cent. appeared to be a fair figure for proper grates, making the evaporative power of the coke 89 per cent. on the basis used in the table.

The capacity of the coke appears to correspond to that of anthracite coal of similar size, and to be about 80 per cent. of the capacity of the best soft coals, such as Cumberland, Pocahontas and New River. By capacity is meant the ability to evaporate steam with a given grate area and draft pressure, irrespective of the economy. In regard to the behavior of the coke, it was found to clinker slightly in a manner similar to the Dominion coal from which it is made, but nowhere near as badly as some of the pea and buckwheat and anthracite coals frequently used.

SAND FILTRATION OF PUBLIC WATER SUPPLIES.*

BY R. S. LEA, ASSOC. M. CAN. SOC. C. E.

(Continued from last issue).

In England and the continent, however, the experience of many years is available, this method, as we have seen, having been used long before the rationale of the process was understood. In England particularly, many of the supplies are from surface waters made available by means of large storage reservoirs; and in nearly every instance the stored water is filtered before being supplied to the consumers. The new supply for Liverpool, which was put into operation in 1892, comes from an artificial lake formed by damming the Vyrnwy River in Wales. This lake is 68 miles from Liverpool, and lies in a sparsely inhabited district remote from railways or towns. Yet the water from this source, safe as it may appear, is also made to pass through a sand filter before being allowed to enter the distribution pipes. In Germany the use of any surface water without filtration is prohibited by law.

But in addition to the high esteem in which the method is held wherever it has been used, there are certain health and mortality statistics which are perhaps of even greater significance. The typhoid fever death rate is now considered to be a pretty good index of the purity of a city's water supply. Keeping this in mind the tables prepared by John W. Hill, M. Am. Soc. C. E. were examined, and the death rate from typhoid

*From a paper read before the Canadian Society of Civil Engineers.

fever of 66 cities in United States and Canada over a period of years studied. These figures show that the lowest rates are for those cities deriving their supply either from springs or from surface waters which have been subjected to sand filtration carried out in accordance with the strictest modern requirements. They also indicate the general inferiority of the water supplied to American cities when compared with European supplies. Chicago and Berlin have about the same population, yet the typhoid death rate of the former is more than ten times that of the latter; or, in other words, the chances of contracting typhoid fever in Chicago are ten times as great as in Berlin. Out of the many instances showing the beneficial effect of filtration with regard to the prevalence of certain infectious diseases, two of the most noted will be cited, one in Europe and the other in America..

Hamburg and Altona, though under separate governments, practically form one continuous city with a joint population of about 800,000. They both draw their water supplies from the sewage polluted Elbe River upon which they are situated. Altona is the nearest to the mouth of the river, and its water intake being three or four miles further down is below the outfall of both its own sewers and those of Hamburg. The Hamburg intake is about two miles above the city. In 1892 an epidemic of cholera occurred, during which Hamburg, with a population of 622,530, had 17,975 cases with 7,611 deaths, while Altona, with 143,000 population, had during the same time 562 cases and 328 deaths, and in many of the cases credited to Altona the disease was contracted in Hamburg. Wandsbeck (20,000), just across the river from Hamburg, enjoyed the same immunity as Altona. Both of these places purify their water supplies by sand filtration, while in Hamburg the only attempt in that direction was the employment of settling basins. A filtration plant was, however, in process of construction at that time, and was put in operation in May, 1893, since when the typhoid rate has diminished from about 30 to 6 per 100,000. The other case is that of Lawrence, Massachusetts, which is situated on the Merrimac River, a few miles below Lowell. In spite of the great dilution, the water of this river which supplies both cities is seriously polluted by the sewage draining into it from the towns built along its banks; and as a consequence the typhoid fever rates in both places were unusually high. In Sept., 1893, a system of intermittent sand filtration was completed. The effect upon the health of the citizens is shown in the following figures:

Year.	Deaths from Typhoid Fever per 100,000 Population.
1887	114
1888	114
1889	127
1890	134
1891	119
1892	105
1893	80
1894	47 (23)
1895	31 (17)
1896	19 (4)
1897	16

For the last four years the figures in the brackets represent the number of deaths among people (principally mill operatives) who were accustomed to drink canal water without filtration; so that the actual reduction in the death rate which should be credited to the filters is much greater even than the figures indicate. Many attempts have been made during the last 12 or 15 years to improve upon the sand filter, but so far without success. Some of the methods invented involve less expense for construction or give better chemical results; but the thoroughness of the bacterial purification effected by the sand bed has not been equalled by any.

The only one of these methods which has been used to any considerable extent is the American or Mechanical System of Filtration, which is employed in several places in the United States. Sand is the material used in this process also, but it is contained in cylindrical iron tanks. The water enters the tanks, usually under pressure, and is driven through the sand at a rate 50 times as great as the maximum allowed in the case of the filter bed. For this reason the latter method is sometimes referred to as Slow Sand Filtration. With such a high rate the surface film must be formed artificially; and this is done by adding a solution of alum to the water, which forms with the carbonates present a white flocculent precipitate. Such a filter will, of course, soon become clogged; but it can be quickly and easily cleaned without removing any of the sand from the tank. The results produced, under test conditions at least, are undoubtedly good; and it has the advantage over the filter bed of somewhat lower first cost. On the other hand, the charges necessary for repairs and depreciation will be considerably higher on account of the less permanent character of its construction; so that if proper allowance could be made for this, the difference in the actual cost of filtering a given quantity of water by either process would not be very great. In any case it will probably not involve an addition of more than 10 per cent. to the ordinary cost of the water. Indeed, calculations have been made showing that if a proper valuation is put upon the lives saved by its use, the construction of a filtration plant is often in the long run a source of economy. Such considerations, however, seem quite unnecessary. A city's water supply should be pure, wholesome, and attractive in appearance, just as the streets should be clean and well paved, and the public buildings architecturally beautiful. Besides, having gone to the expense of obtaining a public water supply, indifference with regard to its purity or unwillingness to provide for it would seem to be utterly unreasonable; especially when it can be secured for such a comparatively small increase in the total cost as sand filtration involves.

It would be much cheaper, of course, to purify only that part of the supply which is used for purely domestic purposes. But that would require a double set of distribution pipes; and we should also lose the satisfaction of knowing that the whole of the public supply could be used for any purpose with perfect impunity so far as health is concerned. And when we consider that the expense of filtering the whole supply only amounts to two or three cents per month for each consumer, it will scarcely be considered excessive.

METAL IMPORTS FROM GREAT BRITAIN.

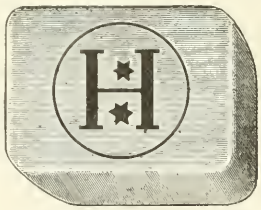
The following are the sterling values of the imports from Great Britain of interest to the metal trades in September, 1898-99, and the nine months ending September, 1898 and 1899:—

	Month of Sept.		Nine Months ending September	
	1898	1899.	1898.	1899.
Hardware	£2,803	£2,018	£17,420	£15,188
Cutlery	3,704	5,538	39,545	39 304
Pig iron	273	5,792	8,386	14,607
Bar, etc.	405	3,288	6,676	14,257
Railroad	2,147	55,311	9,119	113,902
Hoops sheets, etc.	8,059	16,203	44,181	84,510
Galvanized sheets	4,371	8,952	43,712	49,069
Tin plates	5,268	23,394	101,437	141,660
Cast, wrought, etc., iron	3,188	7,435	10,850	39,750
Old (for re-manufacture)	—	1,766	3,574	4,190
Steel	4,203	16,917	30,388	69,677
Lead	4,192	1,657	23,918	34,007
Tin, unwrought	417	4,218	12,292	18,433
Cement	2,859	3,704	17,083	22,643

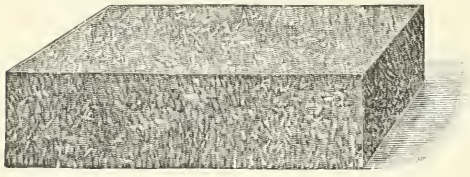
DRAUGHTING.

A most important feature of any engineering or manufacturing establishment is its draughting room. Here the draughtsman prepares the designs for work or machinery it is intended to construct, and on the character and accuracy of the draughtsman's work a great deal depends. For the successful prosecution of his work the artist requires good light and suitable materials. Up to a recent date no Canadian house carried a stock of mathematical instruments and drawing materials adequate to the wants of a manufacturing country such as Canada has grown to be, and supplies of this character have had to be procured from abroad, involving delay and much expense to obtain the same, and not always with satisfactory results. The Art Metropole, of Toronto, has been gauging the wants of manufacturers and engineers in this respect, and has been steadily adding to the stock such articles as leading draughtsmen regard as the best for their purpose. And to-day, it is claimed there is no better stocked house in America in this line than the Art Metropole, Toronto. Here will be found mathematical instru-

ments of the highest grade, the most popular brands of tracing linen, blue print papers, drawing and detail papers, as well as all the lesser accessories such as pens, inks, pencils, rubber, etc., any of which articles may discomfort the user very much, if not of good quality. We illustrate a few things, seemingly small in themselves, but in many cases of great value to a draughtsman.



For example all can appreciate a good rubber, and we here show what is claimed to be the best draughtsman rubber, namely, Hardtmuth's grey pliable rubber, which erases readily without abrasion of the surface of the paper. It may be had in a variety



of sizes. Another rubber indispensable to the artist is a good sponge rubber, which makes a soiled drawing look fresh and new with a few strokes. This is also illustrated. Pens suitable for artists and draughtsmen are also hard to procure, but this

firm carries a full line of everything in this department. Those which are claimed to be the most popular pens for draughting, and for illustration are shown here.

LITERARY NOTES.

A very convincing little circular is that issued by the B. F. Sturtevant Co., of Boston, Mass., regarding their exhaust heads, which shows that by the utilization of centrifugal force in the operation of this head, the water is thrown outward with 1,000 times the force exerted upon the steam, and is thereby absolutely separated from it.

"Modern Buildings of New York City" is the theme of one of the most artistic publications issued in the interests of the valve trade. It contains some fifty pages, and beautiful photo engravings of these buildings are shown, amongst which we notice the New York Life, The Empire, Commercial Cable (21 stories), Postal Telegraph, St Paul Building (25 stories), Siegel, Cooper Co., New York Athletic Club, New York Herald, and Hotels Majestic, Netherland, Savoy, Manhattan Waldorf, Astoria, and numerous other modern edifices in which are used Fairbanks' valves. The Fairbanks' Co., Montreal will be pleased to furnish architects names of architects erecting these buildings in given and others interested in valves, etc., with a copy of the book. We congratulate the Fairbanks' Co. in finding out such a work of art so free from ordinary common place advertising features which so often mar a book of this nature.

Wall Cards, H. & J. published by the Mechanics' Supply Co., Quebec are original in composition, and of great service to parties doing a plumbing. French and English plumbers' supply trade, as well as to machinists' tool users. The names of tools, fittings, furnaces, and valves are given in both languages. The printing is excellent, and the general appearance of the cards make them worthy of a place in any office, machine or plumbing shop.

The annual report of W. Bell Dawson, C.E., engineer-in-charge of Tidal Surveys in Canada, has been issued in the usual Blue Book. It is a report of progress, and as such is welcome. The department is most ably conducted, and the criticisms which are made of its works from time to time in the public press are only criticisms of the small amounts devoted to this service by the Government, not to the way it is expended.

"Small Engines and Boilers" is a manual of concise and specific directions for the construction of small steam engines and boilers of modern types, from 5 h.p. down to model sizes for amateurs and others interested in such work, by E. P. Watson, late editor and proprietor of The Engineer, author of "Modern Practice," "Manual of the Hand Lathe," etc., etc., illustrated, 30 full page working dimensioned drawings. Published by D. Van Nostrand Co., New York.

"The Growing Time in Canada" is the title of a handsomely illustrated pamphlet issued by The Toronto Globe. The public buildings of the various provinces and of the Dominion are shown, as well as points of interest in the chief cities. The engraving was done by Moore & Alexander, Toronto, and is a very fine display of the art.

"The Statistical Year Book of Canada for 1898" has been issued from the Government printing bureau by the Dominion Department of Agriculture. This is the fourteenth year of issue, and, as on each former appearance, the Year Book is more interesting than before. A neat folder gives statistics for the past thirty years of the population, revenue, expenditure, public lands, lands in cultivation, postage, shipping, imports, exports, public debt, expenditure on railways and canals, the working expenses of all our railways, their earnings and profits, full details of chartered banks and postoffice savings banks. Geo. Johnson, F.S.S., is to be congratulated upon the excellent work he is doing in preserving in so compact and convenient form the statistical history of the country.

"A Practical Course in Mechanical Drawing," by William Fox, M.E., assistant professor of Applied Mathematics, College of the City of New York, and Chas. W. Thomas, M.E., instructor in descriptive geometry and drawing in the College of the city of New York. There are numerous illustrations. Published by D. Van Nostrand Co., New York.

Our advertising department has received four handsome wall cards from Jenkins Bros., Boston, Mass. They are issued in the interest of their well known valves, "Jenkens'" '96 packing, and the Sellars' pattern injector.

"The Canadian Home Journal" has passed under the management of a new company, called the Canadian Home Journal Co., and the current number shows that the change is to the advantage of its readers. This journal is now the official organ of the Women's Historical Society, and that department has much information of value to every Canadian who cherishes the records of the country's past. The subscription remains the same, $1 a year.

The 5th edition of the Mechanics' Pocket Memoranda is to hand, published by Colliery Engineer Co., Scranton, Pa. This book is very complete and compact, and is intended for machinists, steam engineers, electrical workers and anyone interested in these and kindred branches will find it of great value. It is bound in pebbled black leather, pocket inside cover, gilt title and edges, and rounded corners.

We have just received No. 4, September, 1898, of Specifications, a half yearly publication of over 700 pages issued, for architects, surveyors and engineers when specifying, and for all others interested in building. This most valuable work is published by the proprietors of the Builders' Journal and Architectural Record, London.

Leaks in metallic pipes can be easily stopped by a patching device, a U shaped yoke being passed around the pipe, with the ends of the yoke carrying a detachable head, with a screw in the centre which presses a cushioned patch over the leak.

NEW RECIPROCATING DRILL AND RATCHET SCREW DRIVER.

This drill is used in drilling steel, iron, brass and other metals, as well as all varieties of woods. It is so constructed that the drill runs continuously to the right, during both the forward and backward movement of the driver, hence drills continuously. The pressure to feed the drill is had by the pressure against the head of the tool, which is provided with ball bearing to reduce the friction. There is no tool made just like it. The chuck is of new design, has three jaws, is accurate, strong, durable, and will not get out of order. No drill points are furnished with this tool—the user furnishing such quality, style and size best suited for work required in wood, iron, steel, brass, etc.

NEW RECIPROCATING DRILL.

The chuck will hold any drill with shank 3-16-inch diameter or less. To open or close chuck move the driver up to chuck, push down the catch in lower end of driver, which holds fast the driver on spindle. After drill is put in chuck and tightened, push up the catch, releasing driver from spindle so it can be moved backward and forward to operate drill. The movement or traverse of the driver is $8\frac{1}{2}$ inches, and full length of tool (without drill), is 16 inches. Every tool guaranteed.

Most ratchet screw drivers made possess one very serious drawback in practical use—that the friction in ratchet mechanism is so great that unless a screw is first made tight in wood by some other means the ratchet screw driver turns the screw out in its backward movement as fast as it is driven in by the forward movement of the driver. The screw is simply turned in and out, no progress made in getting it to its place. The blade of driver instead of remaining at rest during backward movement is carried back by the excessive friction of ratchet and pawls, and the screw with it, except the screw is first driven tight enough in wood to outbalance this friction. Most ratchet drivers are quite noisy in their operation, unhandy to change from right to left, made in a quite limited range of sizes and too high in price to make them popular. This ratchet driver over-

RATCHET SCREW DRIVER.

comes all these faults. The friction in ratchet mechanism is so slight as to be hardly felt, the backward movement is as easy as in a good "stem-winder" and just as noiseless. When a screw is screwed in it stays where put, and is not screwed out when handle is turned back. The construction of ratchet and pawls is such that neither can bend or break, wear or get out of order, and permits a very compact arrangement. The adjustment for right or left hand is exceedingly simple. For right hand or to ratchet a screw in, push the slide to end of slot towards bit; for left hand or to ratchet a screw out, push the slide towards handle of driver. If the slide is placed midway between ends of slot, the blade is held rigidly and the driver can be used as an ordinary screw driver with fixed blade. The materials and workmanship are of superior quality in every detail. The drivers are strong, durable, handsomely finished, and are made in these sizes, 2, 3, 4, 5, 6, 8, 10, 12 inches. North Bros., Philadelphia, are the makers of these new and interesting tools, and in the Aikenhead Hardware Co.'s advertisement on another page, others just as unique will be found illustrated.

—The city of Nicolaiev, Russia, is about to install a complete system of water supply. The water is to be taken from a depth of sixty to ninety feet by a series of wells, a collecting basin, and a standpipe. The plant is to be based upon a supply of about 2,000,000 gallons per day of eighteen hours. The pipe will amount to about sixty miles, dimensions not stated, with all necessary connections and fireplugs. Two pumping engines are specified, with Babcock & Wilcox boilers. Tenders for the plant as a whole or in part will be received for about four months. Interested parties should communicate with V. A. Datsenko, mayor of Nicolaiev, Cherson, Russia.

PAVEMENTS BETWEEN STREET RAILWAY TRACKS.*

BY C. H. RUST, CITY ENGINEER, TORONTO.

In 1891 the exclusive privilege of operating the street railways in the city of Toronto, for a period of thirty years, was disposed of to a company now known as the Toronto Railway Company. The clauses of the agreement, made between the city and the company, that refer more particularly to this paper, read as follows:

"The purchaser shall maintain the ties, stringers, rails, turnouts, curves, etc., in a state of thorough efficiency and to the satisfaction of the city engineer, and shall remove, renew or replace the same as circumstances may require, and as the city engineer may direct. When a street upon which tracks are now laid is to be paved in a permanent manner, on concrete or other like foundation, then the purchaser shall remove present tracks and sub-structures, and replace the same, according to the best modern practice, by improved rails, points and sub-structures of such description as may be determined upon by the city engineer as most suitable for the purpose, and for the comfortable and safe use of the highway by those using vehicles thereon, and all changes in the present rails, tracks and roadbed, construction of new lines or additions to present ones, shall be done under the supervision of the city engineer and to his satisfaction.

"(A). In the event of the purchaser desiring to make any repairs or alterations to the ties, stringers, rails, turn-outs, curves, etc., on paved streets, the purchaser shall repave the portion of the roadbed so torn up at his own expense.

"11. When the purchaser desires or is required to change any existing tracks or sub-structures for the purpose of operating by electric or other motive power, approved by the city engineer and confirmed by the council, the city will lay down a permanent pavement in conjunction therewith upon the track allowance (as herein defined) to be occupied by such new tracks and sub-structures. This shall first apply only to existing main lines and thereafter to branch lines or extensions of main lines and branches, as and when the city engineer may from time to time recommend and the city council may direct and require; but such tracks as are now laid on a permanently formed roadway must, when so required as aforesaid, be changed by the purchaser as hereinbefore provided, without any change of roadbed being made or any expense occasioned to the city thereby."

Under the terms of the agreement the company pays the city treasurer $1,600 per annum per mile of double track and 8 per cent. of the gross receipts. When the receipts exceed $1,000,000, 10 per cent. is to be paid. To raise the money for constructing these permanent pavements debentures were issued, payable in ten years, and the revenue derived from the mileage and percentage of gross receipts is used to pay interest and sinking fund upon these, the total amount of bonds issued up to the present time being $1,210,776, and the annual payment to provide interest and sinking fund is $149,136. This is at present very nearly the amount received from the street railway company, but as these pavements between the tracks will last for a much longer period than ten years, in a few years there should be a considerable revenue derived from this source.

A great diversity of opinion has arisen as to the meaning of the word "permanent," used in connection with pavements. In 1888 this question was in the High Court of Justice before Judge Rose, in a case brought by the corporation of Toronto against the old Toronto Street Railway Company, and after a considerable litigation it was finally settled, without, however, the judge giving his opinion as to the meaning of the word "permanent." When the present company obtained its franchise the interpretation of the word was again subjected to a great deal of discussion, and in 1893 the continuation of the work of changing the rails by the company and the construction of the pavements were postponed from April until August, pending a settlement as to the meaning of this word. The writer has always taken the ground that in this case the word "permanent" refers to pavements with a concrete foundation, and this has since been taken as the meaning of the word as mentioned in these clauses. It is a great pity that this word should be so frequently used in connection with pavements. It would certainly be well in future cases to state explicitly what is a permanent pavement.

*A paper read before the American Society of Municipal Improvements, at the Toronto Meeting

In compliance with the provisions contained in the previously mentioned clauses, in the spring of 1892 plans and specifications for paving the track allowance on King, Queen, Yonge and other streets were prepared, and on the 28th of June, 1892, the Street Railway Company laid down a temporary track on King street, west of Simcoe street, and the contractor for the pavements commenced work. The work of changing the tracks and constructing permanent pavements on the above streets was carried on continuously until winter set in (with the exception of a week's intermission during the time of the Industrial Exposition). The amount of track taken up and relaid this season was 29.9 miles. The rail adopted by the company and approved of by the city was a 6½-inch steel girder rail, weighing seventy pounds to the yard, and having a web three-eighths inch in thickness and a base of 4½ inches wide. A slight alteration was afterward made in the size of the base, making it 5 inches instead of 4½ inches. The rail now weighs about seventy-three pounds to the yard. From experience since gained a heavier section of rail should have been used. The following are the quantities required to build one mile of single track: 114,714 tons of seventy-three pound rails per mile; 5.85 tons of fish plates, seventeen pounds per pair; 1,800 cedar tires; 1 ton of spikes, three-quarters pound each; 1 ton of bolts and nuts, one pound each.

The work of constructing these pavements and the laying of new rails was carried on continuously until the work was practically completed in 1894, there being only a few extensions constructed since. In constructing these new pavements the street railway company took up the old rails, tamped the gravel under the ties, put down new rails and lined and leveled them and the paving contractor did the rest of the work. It may be of some interest to give the amount of work done in each year, the average cost per lineal foot (the width paved being 15 feet for double track), the average rate of progress per day and the different classes of paving material:

1892—20.9 miles single track cost	$322,555 00
1893—26.1 miles single track cost	392,030 00
1894— 9.8 miles single track cost	116,942 61

Average cost per lineal foot of double track for the different classes of pavement during these years was:

Asphalt	$5 23
Granite	2 43
Brick	4 21
Cedar blocks	3 83

This covers the cost of stone or scoria toothing, but where granite was used the contractor was allowed to relay the blocks that were on the street. Average amount done per day was:

Asphalt—131 lineal feet of double track.
Granite—56 lineal feet of double track.
Brick—73 lineal feet of double track.
Cedar blocks—96 lineal feet of double track.

In 1894, on McCaul street, the method of construction was slightly altered as to the system of laying the granite or scoria toothing. It was found that when the blocks were laid as headers and stretchers that the water lodged next to the block and assisted in destroying the asphalt. To prevent this it was decided to lay scoria blocks, 4 x 5 x 9 inches, parallel to the rail, and then lay the asphalt. The practice had been to lay the first six inches of concrete up to the bottom of the rail, then lay the scoria blocks in mortar, and finally put in the remainder of the concrete. On this street a change was also made in this respect. The whole of the concrete was put in at once and while still wet scoria blocks were pounded into it and left to consolidate with the concrete before the asphalt was laid down. In any extension constructed since 1895 wooden ties have been dispensed with and steel tie bars, 2 x ⅜ inches, placed 6 feet apart, are used, the rails being laid on a solid bed of concrete 8 inches in depth by 20 inches wide. This method of construction is much superior to the first type adopted, and is largely used in other cities. After an experience of six years of the different materials used, it is evident that, with the conditions existing in Toronto, asphalt is not a suitable paving material to be used between street railway tracks. After having been down only four years the asphalt commenced to disintegrate. This was at first more noticeable where the asphalt joined the toothing, but it was not long before the rest of the material between the rails commenced to wear into holes. This was due probably to the following causes: The lack of proper foundation under the ties, which was shown by the settlement of the rails in several places, the impossibility of properly tamping the asphalt between the toothing, and the constant watering of the asphalt, rendered necessary by the dust caused by the passage of the cars, and also by climatic conditions. Upon King street, which was the only asphalt pavement laid without toothing, a rut was soon formed, rendering necessary constant repairs. The fact of the lip of the rail not being quite as high as the head, and the gauge of the track being 4 feet 10⅞ inches instead of 4 feet 8½ inches, probably had a great deal to do in forming this rut.

As previously mentioned, the first pavements were laid in 1892, and in 1897 it became necessary to commence tearing up the asphalt and replacing it with granite, scoria or brick, depending upon the amount of travel upon the street. By 1900 all the asphalt between the rails will have been replaced by a more permanent material. Up to the present time seven and one-half miles of this work have been done. As these asphalt pavements were guaranteed for five years, arrangements were made with the contractors whereby they substituted brick for this asphalt, and were paid $1.50 per square yard, but afterward when the guarantee expired the price paid for substituting scoria for asphalt averaged about $2.40 per square yard. This includes taking up the old asphalt and also four inches of concrete. The amount of money spent up to the present time in substituting a more permanent material than asphalt is $137,340.19. In putting in blocks in place of asphalt, the asphalt was first taken off and then the concrete had to be picked out so as to afford room for the blocks, which were bedded on a cushion of sand. Fortunately, on most of the streets the concrete was put in between the rails just to a depth of four inches, and it was not a very difficult operation to take this out. Granite is no doubt the most durable material to use between street railway tracks, but owing to the very strong opposition of the cyclists to this material not so much of it was used as the department would have liked, and scoria blocks, imported from England, were used instead. On streets where there was not a great deal of travel Canadian bricks were used. Cement grout was almost entirely used for this work, although some filling was done with paving pitch; but cement was found to be the most satisfactory. Owing, however, to the impossibility of stopping street car traffic while this work was in progress, it was very difficult for the filling to become properly set. On King street during the past summer, where we were substituting scoria block for the asphalt, a portion of the pavement between the tracks was laid with concrete. It has been down now some two months, but not long enough to know the result.

ORIGIN OF THE B. GREENING WIRE CO., LTD.

Wire, in its various manufactured forms and composition, has during the present generation become so important a factor in some of the great inventions and engineering achievements, that a few facts as to its uses and manufacture may be interesting to many of our customers. It is but within the present century that the electric telegraph, the ocean cables, the great suspension bridges, the useful and important telephone, the electric railroads, the drilling for natural gas, the making of wire fencing, nails, etc., has created such an immense demand for this article, and stimulated an industry that now takes such high rank amongst manufactures. The art of making wire has been traced back to the year 1700 B.C. Gold wire decorated the sacerdotal robe of Aaron. A specimen of wire, made by the Ninevites 800 years B.C., is exhibited at the Kensington museum, London, England. Homer and Pliny referred to similar productions in their early writings. Metal heads, with imitation hair of wire recovered from the ruins of Herculaneum, are in the Portici museum, Naples. From such remote eras up to the fourteenth century, wire in its general acceptance was produced by hammering out strips of metal, and not by the process of "drawing," as now practiced. In the middle ages this industry was extensively pursued, and the artificers thus engaged were termed wiresmiths, but in the earliest days of the manufacture, gold, silver and bronze appear only to have been used. It is substantiated by technical records that the present method of drawing wire was practiced in the Lenne district of Germany during the fourteenth century, and about the year

1350 a wire drawing mill was erected at Nuremburg by a man named Rudolph.

The first needle manufactory in France was started by an Englishman, named Christopher Greening, at St. Omer, and the town recently celebrated the four hundredth anniversary of the establishment of the industry. About 1600 A.D., it is recorded that at Tintern Abbey on the Wye, pins and needles were manufactured by one Greening by name. In the year 1630, a proclamation was issued by Charles I. to the effect that the home industry had made such advancement that further imports of wire were prohibited. About the year 1799, Nathaniel Greening, who came from Tintern Abbey, commenced the manufacture of wire at Warrington. A few years later the firm of Greening & Rylands was established, and carried on business until the year 1840, when the partnership was dissolved, Mr. Greening taking his sons into business, and establishing the firm of N. Greening & Sons; Mr. Rylands' sons continuing under the firm name of Rylands Bros. It was with the firm of Greening & Rylands that the late Benjamin Greening, second son of N. Greening of the firm in question, served a seven years' apprenticeship as a wire drawer; then, commencing business for himself, continued until 1858, when he removed to Canada, and became one of the pioneers of the wire industry here. Under the firm name of B. Greening & Co. he commenced the drawing of wire, wire weaving and rope making, and for many years carried on a successful and steadily increasing business until his death, in 1877, when he was succeeded by his son, S. O. Greening, who built new works and added many new lines to their already extensive business. In 1889, the B. Greening Wire Co. was incorporated as a joint stock company, with Samuel Owen Greening as president, since which time important additions have been made to their buildings and machinery.

THE BRITISH FIRE PREVENTION COMMITTEE.

The British Fire Prevention Committee, under whose auspices tests of materials are conducted, was founded after the Cripplegate fire, London, of November, 1897, and was fully incorporated early this year. It counts a membership of some five hundred architects, surveyors, engineers, municipal officers and others directly or indirectly interested in fire prevention, among whom are practically all the leading members of the professions named. The offices are at No. 1 Waterloo Place, London, Eng., where the library includes a file of some sixty technical journals from all parts of the world, and the regulations and building acts, etc., of all countries. Regular publications are issued by the committee (over thirty already having appeared), and business meetings are frequently held. The founder was Edwin O. Sachs, the architect. Three of the primary objects of the committee are defined as follows: To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures. To use its influence in every direction towards minimizing the possibilities and dangers of fire. To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable. It is with the idea of meeting these objects that a testing station has been established. The present tests will be of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability will be assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas. All reports on tests solely state the bare facts and occurrences, with tables, diagrams and illustrations, and on no account will reports include expressions of opinion, or any expressions that might be read as comparisons or criticisms. The general arrangement and direction of the tests is in the hands of the executive, and in accordance with certain principles laid down after careful study and experiment. The actual tests are attended by the members of the council and the members of the committee in rotation, care being taken that the attendance is always thoroughly representative of the technical professions primarily interested in the specific object under investigation. As to the financial aspect of the station, the establishment expenses have been met by a special subscription which will also cover the expense of conducting tests of general technical interest. Tests with patented materials, makers' systems, etc., are, however, subject to a scale of charges, but these charges are so figured as to only just cover the actual cost. The services of the members conducting or attending tests are given gratuitously. In the first six months' work at the testing station no less than 27 official tests were undertaken, and the results were embodied in twenty reports. Of these 27 tests there were 5 with floors, 2 with ceilings, 4 with partitions, 7 with doors, 8 with glazing and 1 with treated wood.

THE ENGINEER'S AND ELECTRICIAN'S HAND-BOOK, A REFERENCE DIRECTORY.

When the Canadian Association of Stationary Engineers a couple of years ago determined to publish a hand-book containing in a convenient and compact form a great deal of information which successful stationary engineers require to be familiar with, a number of our leading business houses, whose specialties brought them in close contact with the engineers, such as engine and boiler makers, pump manufacturers, manufacturers of dynamos and electrical machinery, elevators, radiators, belting, oils and engineers' supplies generally, took the opportunity which was offered them of placing their products permanently before the engineers, by securing advertising space in the volume. At the same time they gave tangible expression of their good will to the engineers by aiding in the publication of a work which was of great educational value. The time that the stationary engineers had at their disposal for preparing such a work being limited, it was found necessary to place the business arrangements in the hands of an agent. The members of the committee which had the matter in hand were, James Milne, A. E. Edkins, E. J. Philip, Albert Slute, A. M. Wickens, S. Thompson, Wilson Phillips and Secretary J. W. Marr, of Toronto No. 1. The agent employed was W. H. McCarthy, with whom the committee made such liberal terms as to entirely free the society from the suggestion that the venture was in any sense a commercial one. The educational features were paramount and the good of the order was the only object sought.

The agent's work was rendered very light, because the credentials given him by the committee were in most cases sufficient to ensure his receiving an order for an advertisement when they were presented to those, who, as we have already explained, were interested in the success of the project. We append the letter of introduction given the agent:

Toronto, Sept. 13th, 1897.

To Whom it May Concern:

This is to certify that the bearer, W. H. McCarthy, is authorized to solicit advertisements for Engineer's Manual, to be published under the auspices of the Canadian Association of Stationary Engineers, and to collect for such advertisements on publication of said Engineer's Manual.

Given under our hand and seal this 13th day of September, 1897.

[Copy].

JOHN W. MARR,
Secretary, Toronto No. 1, C.A.S.E.

Notwithstanding the generous terms made with the agent, the association was obliged, after the publication of the book, to enter suit in the Division Court, their solicitors being McLean & McCallum, to recover from Mr. McCarthy the small percentage of the receipts which was the association's share of the proceeds. It was impossible to serve a writ, however, as the defendant had removed himself beyond the jurisdiction of the Court.

A short time ago one of our advertisers handed us a shabby volume without an index, whose pages were not even numbered. Its title set forth that it was the Engineer's and Electrician's Hand-Book and Reference Directory, provincial edition, compiled and published by the Reference Publishing Co. The reading matter in the volume seems to have been selected at haphazard from former hand-books, from technical journals and from the household columns of the country weeklies. Such valuable bits of information as the following are happily illustrative: "To soften old putty in sashes—run a red hot iron over it and it will peel off easily." "To find the weight of a grindstone 4 feet 6 inches in diameter, 7 inches thick," etc.

The chief interest in this literary venture lies, however, in the fact that many of the leading advertisers in the Engineer's

Manual, compiled by the Canadian Association of Stationary Engineers last year, are also found in the pages of this unfathered publication. Almost at the same time as we received the Reference Directory, we received the following letter:

Editor Canadian Engineer:

Sir:—There have been a number of enquiries lately about an engineer's hand-book. I am authorized by the Book Committee to state that the C.A.S.E. have not issued a book this year, neither have they authorized any person to get one out for them.

Yours respectfully, W. J. Webb,

October 26th, 1899. Secretary Toronto No. 1.

The columns of The Canadian Engineer have been at the service of the C.A.S.E. since the formation of the association, and we determined to investigate a matter so closely affecting its interests, and also those of the commercial world generally. The majority of advertisers in the Engineer's and Electrician's Hand-Book and Reference Directory were found to be under the impression that this book was being brought out under the auspices of the C.A.S.E., because the volume shown them when canvassed by the advertising solicitor was a handsome leather-bound copy of the Engineer's Manual of the year before, and the solicitor was W. H. McCarthy, who had been the agent of the C.A.S.E. the year before. A rumor, which we were unable to confirm owing to the advertisers being out of town, states that the original letter was also used to secure advertisements.

Several of the advertisers, such as the Jubilee Grate Bar Co. and the Downer Pattern Works, having become suspicious of the bona fides of the publication, refused payment for the advertisement and the copies of the book ordered, claiming that they had believed the book to be published by the C.A.S.E., and that the books delivered were very inferior to the sample submitted. Suit has been entered to compel payment in these cases, and a number of adjournments have been granted at the request of Mr. McCarthy's solicitor, he being out of the country, where he will probably remain.

Other advertisers only discovered the true state of affairs during the course of our investigation. They had unhesitatingly paid their accounts, being fully persuaded that the Reference Directory was published by the C.A.S.E. Among minor irregularities perpetrated we found that limited editions were gotten up for delivery to special advertisers, who believed the terms of their contract were similarly carried out in the whole edition. G. F. Haworth, of Sadler & Haworth, in placing his advertisement had stipulated that in consideration of the price paid no other advertisement of leather belting was to appear. There certainly is no other such advertisement in the fifty copies which were furnished to Sadler & Haworth, but the Beardmore Co.'s advertisement appears on the back cover of all other copies of the issue which we have traced. Norman G. Macleod, with the Beardmore Belting Co., Ltd., assures us that he was told by Mr. McCarthy that the C.A.S.E. was publishing the work, and Mr. McCarthy sold him the space in the book which is now occupied by Sadler & Haworth, afterwards offering to move the Beardmore Belting Co.'s advertisement to the back cover without charge. Thus he carried out his promise to give Sadler & Haworth the only advertisement of leather belting in the book. The following firms have been interviewed by a representative of The Canadian Engineer, and all tell practically the same story of misplaced confidence. In some cases the prices paid were one hundred per cent. greater than others: Beardmore Belting Co., Sadler & Haworth, E. Rogers & Co., Coulter & Campbell, Mica Boiler Covering Co., Aikenhead Hardware Co., Jubilee Grate Bar Co., Reid & Brown, Westman & Baker, Downer Pattern Works, Dodge Mnfg. Co., Redpath, Reid Automatic Smoke Consumer Co., Pendrith & Co.

The other firms whose advertisements appear in the Reference Directory, but whom time or circumstances have prevented us calling upon are: Canada Metal Co., Rice, Lewis & Son, Morrison Brass Co., Burns & Co., Conger Coal Co., Standard Fuel Co., Royal Electric Co., United Electric Co., P. H. Patriarche Boiler Insurance Co., St. Lawrence Foundry, Luxfer Prism Co., A. R. Williams, Queen City Oil Co., Canadian Rubber Co., Chas. H. Riches, B. & H. B. Kent, and Fetherstonhaugh & Co.

We are sure that the full account of this affair which we have given will be of interest, not only to those directly affected but to all who recognize legitimate advertising as the path to success in business. Too often wide-awake business men invest money in advertising without any of the careful investigation which they would bring to bear on any other transaction involving a similar amount. In this way grave injustice is done to legitimate advertising mediums, which have been built up by great expenditure of time and money.

THE EVERETT COKE WORKS.

The coke ovens at Everett near Boston, Mass., which H. M. Whitney stated some time ago would soon use three-quarters of a million tons of Nova Scotia coal a year, are described in a recent issue of The Mining Record: Four only of the many by-products of coal are sought for at the works, namely, coke, gas, tar, and sulphide of ammonia. All of the tar is disposed of to the National Tar Company, while for the ammonia there is a ready general demand. As yet little or no gas is being disposed of, as connections with the mains of other gas companies have not been completed. On the wharf there are towers for discharging, of the same kind as those erected by the company at Montreal. There are also coal pockets for receiving coal. From the towers the coal is conveyed in tubs by means of an endless rope to pockets situated about the centre of the coke oven plant. From the towers the tubs run until a pocket is reached into which the coal is discharged. The empty tubs do not return by the road they came, but continue on and go up an incline on the opposite side. When an oven is to be charged an iron car, hopper-shaped, is run under a chute—or the pocket—filled and run to the particular oven, as required. The car contains six tons of coal, which is the quantity necessary to a charge. When the coke is ready a steam ram shoves it out into a peculiarly constructed, movable, chute shaped car, with a movable gate at foot, to prevent the coke from running over on to the railroad underneath. This car is, say, thirty feet long. As the coke comes from the oven it falls on, and runs down and over the iron sheets on the car. As the coke fills the space on the car in front of the oven door it is moved along until the whole surface of the car is covered with coke. During the time of discharging water is poured on to cool the coke. The coke comes out of the oven in an almost solid mass, but breaks some, of course, on falling into the car. After the coke has cooled sufficiently, the iron gate on the car is lifted, and the coke runs into railway coke cars. After January, 1900, there will be 400 ovens, which will require no less a quantity than 2,400 tons of coal daily. This, after making allowance for an occasional oven being allowed to cool for repairs, will bring the quantity of coal necessary, in charging the ovens for a year, up to 750,000 tons, the quantity stated by Mr. Whitney that would be required. With so much favor has the coke, for locomotive and other purposes, been received, that it is in contemplation to erect an additional 400 ovens. That would mean an annual consumption of coal of 1,500,000 tons, and an annual revenue to the province of the large sum of $187,500. The gas made so far has been employed chiefly in the burning of the coke, and in heating the uncharged ovens. Each ton of coal produces 10,000 feet of gas. Of this quantity 48 per cent. returns to the ovens, to produce heat. The more gas returned to the ovens the quicker made is the coke. When all the ovens have been heated 50 per cent. of the gas made will be returned for the purpose of quicker burning. This will leave 5,000 feet of gas, for heating and lighting purposes, for every ton of coal coked. In other words the company will have for disposal, after the 1st of January, the large quantity of 12,000,000 feet of gas daily, a quantity much larger than is consumed by all of Boston and its environs.

The Berlin, Ont., Rubber Mnfg. Co., Ltd., has almost finished installing its plant and already some 75 tons of machinery are in place. The main building is white brick, three stories, 158.53 feet; the boiler-house is 48 x 50 feet, with a chimney 100 feet high. The contract for the motive power went to Goldie & McCulloch, Ltd., Galt. There are two large horizontal return tubular boilers of 130-h.p. each. These boilers will be fired by two Jones underfeed automatic stokers, supplied by the General Engineering Co., Ltd. On the premises is an 8-inch artesian well, 255 feet deep, to supply water. The officers of the company are: J. Kaufman, president; A. L. Breithaupt, secretary-treasurer, and George Schlee, manager.

Industrial Notes.

The gas company at Sarnia, Ont., is laying larger mains.

Willis Chipman, C.E., has prepared plans and estimates for waterworks in Gananoque, Ont.

R Dillon, Oshawa, Ont., maker of saw sets and cross-cut saw handles, is putting in a plant for forging bolts, nuts, etc.

The Imperial Paper Mills, Sturgeon Falls, Ont., want that town to give them an additional bonus of $12,000 with several other privileges.

The dam of T. G. McMullen's pulp mill at Union, N.S., was carried away October 14th. It will not be rebuilt before next summer it is said.

The Maritime Clay Works, at Pugwash, N.S., are under contract to supply the Dominion Iron and Steel Company with 7,000,000 bricks.

Ritchie & Ramsay, manufacturers of coated papers, New Toronto, have erected an extension 100 x 60 feet, three stories high, to their factory.

The heating apparatus in the Penetanguishene, Ont., Reformatory has been changed from wood to slack coal burning. A considerable saving will be effected.

The Waterloo, Ont., water tower will be 115 feet high, diameter, 20 feet; capacity, 225,687 gallons. Hunter Bros., of Kincardine, are the contractors. The cost is $6,000.

The Syracuse Smelting Works, Montreal, are now running day and night. Orders received by the company before the annual inventory is taken will be filled at special prices.

The grist mill recently completed by R. J. McDougal & Son, Lancaster, Ont., is supplied with power by a 20-h.p. gasoline engine, manufactured by Goldie & McCulloch, Ltd., Galt, Ont.

It was stated some time ago that a well-known hardware merchant of Halifax, N.S., and another of Dartmouth, N.S., were about to put up a rolling mill at the latter town. The Maritime Merchant now announces that they will establish a steam laundry.

Oelschlager Bros., Berlin, Ont., are putting in an elevator at Schaefer, Killer & Co.'s, Waterloo, and one into C. H. Doerr & Co.'s, Berlin, biscuit factory, and have an order for a two ton elevator from the Berlin Rubber Co.

September, 1899, is the banner month for business in the history of the Austin Separator Co., Detroit, Mich., manufacturers of steam and oil separators. The Austin is one of the oldest baffle plate separators on the market, and one of the most popular.

Fred. C. Beresford, London, Ont., superintended the drilling of ten wells for the Berlin, Ont., waterworks. The wells are an average of 150 feet deep and will furnish a daily flow of 1,000,000 gallons. Berlin has hitherto had a water supply from a small lake. The well water is said to be of very fine quality.

Waterloo, Ont., has leased a suitable lot for a furniture factory to the furniture firm of Lippert & Pommer for a term of ten years at a rental not to exceed the school taxes on the lot and building. At the end of the ten years the lot will be deeded to the company if they are still in business and employ at least twenty-five skilled workmen.

J. M. Ruddock, of the Miramichi Foundry and Machine Works, was the successful tenderer for the super structure of the new steel bridge across the Nashwaak at Marysville, N.B. There will be four spans of 112 feet each and one span of 43 feet. The work will be done at Chatham, N.B., and taken to Marysville by the Canada-Eastern railway for erection. The price is about $25,000.

The buildings of the Cushing pulp mill, near St. John, N.B., which will be complete by the end of the present month, cover 56,517 square feet, and comprise the following buildings: Machine, 180 by 66 feet; screen, 144 by 60 feet; blow-off, 144 by 30 feet; digester, 144 by 28 feet; wood, 160 by 45 feet; boiler, 131 by 75 feet; engine, 50 by 60 feet; chemical, 156 by 50 feet. The chimney is to be 200 feet high, and a wharf 370 feet long is being built. The output will be 50 tons of pulp daily, and 250 men will be employed.

Fisk & Co., curriers and fine feather makers, Montreal, are asking Lachine, Que., for a bonus of $25,000 to establish a factory in Lachine to employ 60 people, and pay $35,000 annually in wages.

Edmonton, N.W.T., is offering free site and exemption from taxation for ten years to anyone who would erect and maintain a fully equipped foundry and machine shop within the corporation limits.

J. H. Wilcox, H. Buckel, J. E. McGarvin, F. Wilcox, Alice M. Buckel, Toronto; J. Buckel, New Hamburg, Ont., have been incorporated as the Cyclone Woven Wire Fence Co., Ltd.; capital, $30,000; chief place of business, Toronto.

Last winter the Goldie & McCulloch Co., Ltd., Galt, Ont., sold a "Model" gasoline engine to D. P. Tobin for cutting ice. So well did the experiment work that the company has shipped two more to Mr. Tobin to be used for the same purpose this season.

D. A. Ripley, Pittsburg, U.S.; G. W. Burkhart, J. P. Warrick, Detroit, U.S.; H. S. Warrick, W. A. Smith, Kingsville, Ont., and S. H. Chisholm, Cleveland, U.S., have been incorporated as the Ontario Glass Co., to make glass in Kingsville, Ont.; capital, $100,000.

The Prescott, Ont., waterworks are now practically complete, and water will be turned on about the end of the month. Wm. Watson, whose name is familiar to all readers of our columns as a writer on sanitary matters, has been engaged on the works as inspector for the engineers during construction.

The Carborundum Co., Niagara Falls, N.Y., and Ontario, has just issued a neat little booklet, which shows that carborundum, though a higher priced abrasive than emery, is rapidly increasing its sales. The pamphlet contains a number of letters which say that carborundum wheels are the best in use.

St. Henri, Que., has bonused the Lang Biscuit Manufacturing Company, Montreal. The council exempts the company from all municipal taxes for ten years, the company undertaking to build a factory in the town, and to expend at least $100,000 annually in wages. The company has bought part of the Drummond property, and will erect a building four stories high.

W. McDonald and D. McGregor, Westville, N.S.; R. Bell, D. R. Campbell and J. H. Marshall, St. John, N.B., have been incorporated as the Maritime Glass Co., to carry on the manufacture of ornamental glass by bending, staining, silvering, cutting, etc.; capital, $15,000; chief place of business, St. John, N.B.

Colin Campbell, St. Hilaire, Que.; G. R. Starke, R. D. McGibbon, Q.C., J. A. Prevost and Victor E. Mitchell, barrister, Montreal, have been incorporated as the Arlington Cab Co., Ltd., to buy the business of the Arlington Private Cab Stables, and establish a line of automobile cabs to ply for hire in Montreal; capital, $100,000; chief place of business, Montreal.

Ernest Rolph, of Sproat & Rolph, architects for Lever Bros., of Sunlight Soap fame, has let the following contracts, amounting to over $140,000: Carpenter work, W. & J. Clarke, Toronto; masonry, Cannon & Sons, Toronto; steel structural work, about $50,000, Hamilton Bridge Co., Hamilton; roofing, Forbes Roofing Co., Toronto; galvanized iron work, Douglas Bros., Toronto; soap machinery and soap pans, Jno. Inglis & Sons, Toronto; Heine boilers will be used.

The Goldie & McCulloch Co. has at present a number of large orders for flour milling machinery. Among these are the equipment for a 175 barrel mill at Saskatchewan, N.W.T., to be known as the Farmers' mill, which will be installed in a few weeks; a 50-barrel mill at Leduc, N.W.T., for J. P. Findlay; a 150-barrel mill at Brantford, Ont., for Wood Bros., which has just been put in; and for the Dowling Manufacturing Co., at Edmonton, N.W.T., a mill with a capacity of 175 barrels of flour per day, now being installed. Quite a number of other orders, for smaller mills in various parts of Canada, are also being filled.

The Sissiboo Pulp and Paper Co., which made a successful flotation of stock last month, will absorb the property of the Sissiboo Falls Pulp Co., at Weymouth, N.S., and will build a new mill three miles further down, operating both. The two will have a combined capacity of forty tons of dry pulp per day or about 12,000 tons annually. The work of erecting the new mill will be commenced at once, so that it will be in operation next year.

The Hamilton Bridge Company has taken out a permit to build an addition to its works.

There will be a million dollar station and hotel built by the C.P.R. in Winnipeg next year.

Arrangements are said to be under way for the establishment of a beet sugar refinery at Aylmer, Ont.

The contract for the new sulphite pulp mill buildings at Sault Ste. Marie, Ont., has been let to W. J. Hill.

A great deal of building has gone on in Petrolia, Ont., during the past season.

It is proposed to organize the Lambton Co-operative Creamery Co. among the farmers in the neighborhood of Petrolea, Ont. The capital stock will be about $25,000.

The electrical fountains put into the Crystal Palace, London, Eng., are supplied by pumps built by the Goulds Mnfg. Co., Seneca Falls, N.Y.

A neat folder containing particulars of the large leather belt being made for the Ogilvie Milling Co. has been issued by Sadler & Haworth.

The market for iron and steel scrap is reported very active by the Syracuse Smelting Works, Montreal, which company is large buyers of these materials.

The House of Refuge for Ontario county will be built in Port Perry, Ont., that town having offered a bonus of $5,000, and a free site. The building will cost $20,000.

The Dominion Government has placed an order for an iron show case with the Goldie & McCulloch Co., Ltd., Galt, Ont., to contain the mineral display at the Paris Exhibition.

Fifteen large bagasse filters for sugar plantations in Mexico have just been shipped via New York and Vera Cruz by the Goldie & McCulloch Co., Ltd., Galt, Ont. The same firm has on hand an extensive order for special machinery for the St. Charles Condensing Co., which is building a branch in Ingersoll, Ontario.

F. C. Billings, superintendent of the famous Billings & Spencer works at Hartford, Conn., manufacturers of fine steel drop forgings, writes of the Yankee Twist Drill Grinder, described in our September number: "It is the best drill grinder Billings & Spencer have ever used." This grinder is sold by the Fairbanks' Co., Montreal.

Shurley & Dietrich, Galt, Ont., are now supplying their eastern trade from the Beaver works in Sherbrooke, Que., recently taken over by them. They will also make axes in Sherbrooke. They are also removing the iron bedstead factory from St. Catharines, Ont., lately bought from the R. H. Smith Manufacturing Co., and are putting up a large stone building in Galt for its reception.

The Goldie & McCulloch Co., Ltd., Galt, Ont., is turning out some very large engines of late. Among others are engines for the Vulcan Iron Co., Winnipeg; R. C. Ennis, Neepawa, Man.; the town of Barrie and the town of Prescott; Berlin Rubber Co., Berlin, Ont.; Dominion Bridge Co., Lachine, Que.; Kennedy & Sons, Owen Sound, Ont.; Intercolonial Railway Co., St. John, N.B., and the Standard Shirt Co., Montreal.

During the last two years the development of trade in connection with the Albion Iron Works, Victoria, B.C., has been little less than phenomenal, says The Toronto Globe recently. In 1896 the company were employing about 90 men. To day they have about 260 men on their pay roll. In addition to this they have within the last two years added to their plant, involving an expenditure of $75,000. For the last two months they have had shifts working night and day in order to keep pace with their orders.

It had been cabled from London that there was an extraordinary military parade at Aldershot October 31st, when 15 traction engines and 40 trucks were inspected previous to their departure for South Africa. A stretch of sandy, rocky road was selected for the tests and gave an excellent chance to observe the points of the engines. A steep ditch and banks, two and three feet high, were safely traversed. Though at times the wheels sank to the deep other engines pulled out the disabled ones. The Duke of Connaught and Prince Louis and Victor Napoleon attended the trials, and were much pleased with the result. Twenty four of these engines will be despatched to South Africa.

The B. F. Sturtevant Co., of Boston, Mass., has issued a circular relating to its exhaust heads, which makes clear the efficiency of centrifugal force as a means of separating water and steam.

The Waterloo, Ont., Manufacturing Co., agricultural implement makers, has decided to build an addition to its factory, 200 x 60 feet, two stories high. One story will be completed this fall.

The new buildings erected or in process of erection since January 1st, 1899, in Vancouver, are stated by The World to be valued at $2,475,000, and the value of the municipal improvements also being undertaken at this time amount to $280,000.

There will be three ventilating shafts placed in the northern part of Toronto to ventilate the sewers which in the upper portions of the city at times emit a horrible stench. If this experiment proves successful these ventilating pipes will be generally introduced.

There is a very large prize offered for the best plans for a system of waterworks, drainage and electric lighting for the town of Levis, Que. The prizes are $1,000 for the best and $500 for the second best plan. The details will be found in our advertising columns.

E. Dowling, W. Dowling, R. P. Ottewell, J. H. Dowling, J. B. Dowling and H. W. Dowling, farmers, Northwest Territory, have been incorporated as the Dowling Milling Co., Ltd., with a total capital stock of $40,000, headquarters in the Edmonton Settlement, in the District of Alberta, N.W.T.

The L. S. Starrett Co., Athol, Mass., U.S.A., has decided to discontinue the manufacture of milling cutters, and has sold the stock, machinery and good will of the cutter department to F. J. Gay, for the past five years a partner with them in that branch, and also manager of it. E. T. Ward is to be associated with him under the firm name of Gay & Ward. The L. S. Starrett Co. is confining itself to the manufacture of fine mechanical tools already fairly known in Canada to machinists and the tool supply trade.

The Association of Architects of the Province of Quebec opened its new rooms in Montreal a short time ago by holding a reception, which was attended by members of the association and a number of distinguished guests. Invitations had been given to the president of the Royal Canadian Academy, who was present, and to academicians in Montreal; to the office-bearers of the Art Association, of the Canadian Society of Civil Engineers, and of the Renaissance Club; Dr. Bovey, dean of the Faculty of Applied Science at McGill University; Professor C. H. McLeod, P. W. St. George, the professors of the Ecole Polytechnique, etc. The president of the association, Professor Capper, of McGill University, received the members and their guests.

One of the reasons why Canadian pulp is now so much in demand in England is because of the enormous cost of pulp wood in Sweden, the former source of supply. Formerly a cord of pulp wood, 4 x 4 x 8 ft. cost in Sweden $2.50. Now it costs $10. The industry has so reduced the supply in that country that a reduced cut and practically prohibitive prices have resulted. An instance is given in a contemporary of one English mill in Sweden that had 600,000 logs last year for pulp purposes. Of this lot 300,000 were only five inches at the top, thus showing that the larger trees are getting very scarce. A representative of an English firm lately made contracts in Nova Scotia, it is said, for 25,000 tons of pulp to be delivered next year.

F. S. Evans, of the F. & D. Bicycle Co., recently stated that the very large trade in Canada previously done by the companies now incorporated in the American Bicycle Co. is to be preserved and continued by a syndicate of Canadian capitalists, who have purchased for Canada from the American Bicycle Co. all their patents, rights, good will, and business, and will immediately establish in Canada a complete manufacturing plant, capable of turning out not less than 30,000 bicycles per year. In addition to this plant, the plants of the Canadian Typograph Co., manufacturers of the F. & D. bicycle, the E. C. Stearns Co., and the Wheeler and Christy Saddle companies, will be taken. This plant will be established in Canada in two months. Toronto has been chosen as the site, if suitable buildings can be secured. The company will have a capital of $2,500,000.

The engine in S. G. Parkins' shingle mill, Lindsay, Ont., was wrecked by the breaking of the belt which drove the governor. This threw off the main belt, and the engine raced with the result stated.

After the 15th of November the headquarters of the Canada Cycle & Motor Company, Ltd., will be at the southeast corner of Bay and Front streets, Toronto. They have leased the entire building containing about 25,000 square feet. The entire management for all the factories will be concentrated here, and the offices are now being made ready for the accommodation of the staff. Meanwhile they are occupying temporary quarters on the fourth floor of the Canada Permanent Building, 18 Toronto st.

Marine News.

There appears to be every prospect of the building of the southern portion of the Trent Valley canal.

Angus MacAuley, Southampton, Ont., has received the appointment as captain of the Government Upper Lake patrol boat "Gilphie."

The Richelieu and Ontario Navigation Company paid a dividend of three per cent. out of the half year's profits on the 2nd of November.

The directors of the Quebec, Hamilton and Fort William Navigation Company have accepted the tender of an English firm to build two vessels at a cost of $275,000.

The corporation of North Vancouver is submitting a bylaw to the voters of the district to borrow $12,000 to be used in buying and operating a ferry steamer between Vancouver, B.C., and North Vancouver.

M. Connolly, who has the contract for dredging and building the Government wharf at St. John, N.B., says that he will have the dredging completed and the stone work of the wharf sufficiently advanced to permit of a vessel coming alongside, during the present month.

An order has been placed by the Lodestar Co., Kaslo, B.C., in Liverpool, Eng., for the construction of a hull, boiler and machinery for a new steel steamer, which is to arrive in Kaslo about the end of February next, when she will be put together. The steamer will be 65 feet long and 16-foot beam.

It is reported that the contract for the extension of the Lorne Graving dock, at Levis, is to go to Thomas Powers, Levis, Que., the lowest tendered. Departmental estimates are $117,000, but it is said Powers' tender is above this figure. The dock is to be lengthened from 445 feet to 600 feet.

J. J. Long, president of the Collingwood Dry Dock Company, stated recently that arrangements were about completed for establishing at Collingwood a modern shipbuilding plant of large proportions. Alexander McDougall, Duluth, formerly general manager of the American Steel Barge Company, will be a director in the company. The dry dock will be taken over by the new company.

The water front at the foot of Yonge street, Toronto, known as Pier No 21, will hereafter be called the Richelieu and Ontario Navigation Company's dock. With the new management there will also come new alterations and additions to the wharf. From the foot of Scott street and extending for a distance of 300 feet a new wharf will be built adjoining the present structure. When this is completed it will provide an excellent berth for the palace steamer "Toronto."

The Canada Atlantic Transit Company, recently incorporated, has elected officers as follows: President, J. R. Booth, of Ottawa; vice-president and counsel, H. F. Stevens, St. Paul; secretary, J. T. Rose, Duluth; treasurer and assistant secretary, C. T. Fleck, Ottawa; assistant treasurer, W. H. Burk, St. Paul; general manager, E. J. Chamberlain, Ottawa. Most of the officers are connected with the Canada Atlantic Railway Company, with which it will operate. The company has operated the Menominee fleet of six boats since early in 1897, between Duluth and Parry Sound, and Chicago and Parry Sound. This fleet was recently sold to the National Steel Company, and the Canada Atlantic has purchased the "George Orr" and "Arthur Orr." They will purchase four more vessels.

T. W. Paterson, manager of the Victoria & Sidney railway, states that the company has decided to build a steamer to be on the route by the 1st of February, which is to be a screw vessel, 90 feet long by 20 feet beam, and fitted both for freight and passenger service. Her machinery will be built in Toronto. When on the route she will make two round trips a week to Nanaimo from Sidney, and will spend two other days of the week among the islands, maintaining a mail service, in addition to doing all other transportation business.

Capitalists from the marine provinces are figuring out the possibilities of establishing a trade between the coal fields of Nova Scotia and the iron ranges of Ontario. To carry iron ore from the Atik-Okan or Mattawin deposits, by way of Fort William or Port Arthur, becomes a project well worth consideration when the St. Lawrence canals have been deepened, and a waterway of 14 feet deep established. The vessels would not have to return light, because, being assured of full cargoes eastwards, they could probably afford to carry coal west to Montreal, Toronto, or even Lake Superior ports, at very low rates. The development of the Maritime Provinces coal trade is increasing rapidly. September coal shipments of the Dominion Coal Co. amounted to 196,000 tons, an increase of 32,745 tons over the same month last year. From March 1st to September 30th, this year, seven months, 1,031,500 tons, against 838,285 tons in the same period of last year; increase, 193,215 tons.

Mining Matters.

Campbell & McNabb, Douglas, are working a mica mine at Mt. St. Patrick, Renfrew county, Ont.

A valuable discovery of iron is reported on the property near Dog Lake, in the vicinity of Battersea, Ont.

The Canadian Copper Co., Sudbury, Ont., finds it almost impossible to secure men enough to carry on its work.

The Truro, N.S., Foundry and Machine Co. will have ready in a short time a 60-stamp mill for Waverly, N.S., gold mines.

The Copper Crown Mining Co. is going to extend the I.C.R. at Picton, N.S., to its smelter now under construction, the Minister of Railways having promised to pay the company for the outlay.

The Le Roi Mining Company recently ordered from the Jenckes Machine Company, three 100-h.p. boilers. These will be used to furnish the power for the 40-drill compressor plant, recently ordered by the company, and will be delivered early in March next.

John Cook, director of the Boerth Mining Co., stated recently that the mill at Ardoch, Ont., is running steadily and turning out gold in good quantities. The ore runs an average of $17 per ton, with considerable gold in the concentrates that will be treated later on.

One of the members of the staff of the Geological Survey, recently returned from field work in New Brunswick, states that alluvial deposits of gold have been discovered on the Serpentine, a branch of the Tobique, in Northumberland county, which seems to show splendid indications of the existence of gold in good paying quantities.

The Hall Mines, Ltd., Nelson, B.C., have just closed a contract with James D. Sword for a new steel wire tramway rope 50,000 feet in length. This rope is of a high grade steel, and has a breaking strain of nearly 70 tons, and weighs about 35 tons. It is to replace the old cable, and will be specially manufactured for the work required. This will be the fourth cable used at the mine.

Archibald Blue, of the Ontario Bureau of Mines, returned recently from a trip to the Michipicoten district; he said there was a great deal of mineral, and iron was the principal product. There has not been much development work done yet and there is much room for exploration. A branch of the Algoma Central Railway is being built from the Clergue iron mine to Michipicoten harbor. A branch will also be run to Dalton, to connect with the C. P. R. Surveying parties are going out now to prepare for the Algoma Central.

The Jenckes Machine Co., Sherbrooke, Que., shipped two car loads of mining machinery recently to the War Eagle Mining Co. It will be erected at once.

Railway Matters.

The C.P.R. has ordered ten more compound engines from the Kingston locomotive works.

The Canada Atlantic Railway is building a large number of 35-ton freight cars at its Ottawa shops.

The Shawenegan Falls branch of the Quebec & Lake St. John Railway has been open to traffic since October 23rd.

J. S. O'Dwyer, C.E., returned to Granby, Que., after exploring a route for a projected railway from the headwaters of the Skeena, to the headwaters of the Stickeen rivers, for the Dominion Government.

The Milwaukee Southwestern Railroad Co. announces that it proposes not only to build a line 200 miles long, extending southwest from Milwaukee, but that it intends to go into the lake and rail business, co-operating with the Canada Atlantic.

The Rainy River Railway is being pushed with great vigor by McKenzie & Mann's contractors. Between 5,000 and 6,000 men are at work on a section of 150 miles stretching from Stanley, on the Port Arthur, Duluth & Western Railway, southwesterly towards Rainy River, and next spring 10,000 men will probably be engaged in order to try and complete the line to secure a share of next year's northwest harvest.

The C.A.R. train that took the Government party to the opening of the Soulanges canal ran 81 miles in 76 minutes. Among those on board were, Hons. J. I. Tarte and Fielding; Collingwood Schrieber, Deputy Minister of Railways and Canals; L. K. Jones, secretary; J. R. Booth, E. J. Chamberlin, W. J. Poupore, M.P.; H. B. Spencer, of the Canadian Pacific Railway; E. Marceau, superintending engineer of the Quebec canals; R. B. Rogers, superintending engineer of the Trent canal; R. C. Douglas, of the Department of Railways and Canals; the representatives of the Montreal, Ottawa and Toronto papers, and others.

The Grand Trunk Railway has a surveying party at work making arrangements for improving the grades and double-tracking the line from Hamilton to Niagara Falls, Ont. This special work has been under consideration by the G. T. R. management for some time, and consequently the company of late has been putting in the stone abutments to bridges double width, so as to carry a double track when it would be required. It is expected that the contracts for widening the roadbed, tracklaying, etc., will be let during the winter, and the construction work commenced early next spring, and the double-tracking finished some time next summer. When done this work will complete a double track run from Toronto to Niagara Falls.

Personal.

R. R. Smith, superintendent of the Sherbrooke Street Railway, is ill with an attack of typhoid fever.

W. H. Randall has been appointed foreman of the meter and machine shops of the Toronto waterworks, Soho street.

Jas. Flemming, head of the foundry firm of James Flemming & Sons, St. John, N.B., died October 10th of apoplexy.

H. C. White, of Jenkins Bros., Boston, called on us during the past month. He reports good demand in Canada for this firm's goods.

Alex. Dyer has left Perth, Ont., for Birmingham, England, where he has secured employment with the Birmingham Tramway Co.

H. Orpen, for twenty four years foreman of the meter and machine shops of the Toronto waterworks, was presented with a gold ring by his friends in the department. Mr. Orpen resigned a short time ago.

J. Tees is now representing the Oliver typewriter in Toronto. This machine is built by the Linotype Co.

Chas. Potter, optical instrument maker, Toronto, died Nov. 3rd, aged 68 years, after many years' illness.

J. Laprairie, Montreal, has been appointed by the Canadian Pacific Railway Co., inspector for the car works at Perth, Ont.

E. Lafontaine, assistant engineer of the Department of Public Works, Ottawa, died in Vancouver, Oct. 10th, of typhoid fever.

The death of George A. Browne, traffic manager of the Richelieu and Ontario Navigation Company, took place at Atlantic City, October 12th. He was 40 years of age.

Mrs. Campbell, Guelph, Ont., has been given a verdict for $1,000 and of $500 each to two children in her suit against the Acton Tanning Company for the death of her husband.

Frank H. Pitcher, McGill University, Montreal, who has been demonstrator in physics for the past five years, has just been appointed engineer of the Montreal Water and Power Company.

Thos. Eversfield, engineer in charge of the heating and lighting plant of Toronto University buildings, has resigned, and Fred. Hanmer, formerly machinist at the Fensom Elevator Works, Toronto, has taken his place.

Jas. Gunn, Royal Military College, Kingston, son of Alexander Gunn, postmaster of Kingston, Ont., has received from the Imperial War Office an appointment in Egypt on the staff of the Government railways, under Lieut. Girouard.

T. G. Hazlitt, president and general manager of the Dickson Lumber Company, died at Peterborough, Ont., Oct. 12th. He was a native of county Armagh, Ireland, and came to Peterborough when a young man, and engaged in the lumbering business. In 1870 he became manager for the Dickson Lumber Company. He was 76 years old.

Joseph Smith, bridge foreman on the Canadian Pacific Railway on the North Bay division, while recently engaged in the work of repairing the trestle near Desbarats station, was struck by a passing train and knocked off the trestle, falling on his back, a distance of about fifty feet. He was removed to the hospital at North Bay, Ont., in a most critical condition.

C. N. Coburn, who has been looking after the engineering work in connection with double-tracking C.P.R. main lines in Ontario, has been appointed resident engineer of the C.P.R., at Smith's Falls, Ont. He supersedes A. K. Kirkpatrick, who, it will be remembered, was selected some time ago by the British Government to be engineer of the government railroads in Egypt.

The position of General Manager of the Canada Cycle and Motor Company, limited, has been offered to and accepted by Joseph N. Shenstone, the well-known secretary of the Massey-Harris Company, Ltd. He had much to do with the building up of the successful business of A. Harris, Son & Co., of Brantford, and since the formation of the Massey Harris Co., Ltd., has been a director and secretary of that company.

The remains of the late James A. MacMahon, railway contractor, son of the late Philip MacMahon, were interred in Dundas, Ont., October 16th. Mr. MacMahon was born in the town of Dundas 47 years ago, and his life has been spent in contracting. He had just been awarded a contract for 90 miles of railway construction in Eastern Canada, when he died. Amongst the large engineering works which deceased superintended may be mentioned the Government dry dock at Levis, Que., section 33 Welland Canal, several large contracts on the C.P.R., G.T.R., M.C.R., and the Canada Atlantic Railway bridge across the River St. Lawrence at Cotean Landing.

Ottmar Mergenthaler, the inventor of the linotype, died at Baltimore, Md., October 28th, of consumption. He was born in Wurtemburg, Germany, in 1854, and came to the United States penniless and friendless, when 18 years of age. He was employed by a Baltimore firm that was making some models of printing machines for James O. Clephane a Washington stenographer. He took a deep interest in the work, and for four years devoted his time to inventing a type setting machine of his own. After many experiments he made a complete change of system in 1880, and adopted the plan which resulted in the present linotype machine.

We regret that the senior member of the firm of the Brown & Sharpe Manufacturing Co., Lucian Sharpe, died at sea while returning from a trip to Germany. The deceased was born March 20, 1830. He worked on his father's farm in his youth and received a common school education. Leaving the farm, he served a five years' apprenticeship with Joseph Brown, and was admitted to a partnership in 1853. The firm of Brown & Sharpe was incorporated as the Brown & Sharpe Manufacturing Co. in 1868.

Iron and Steel.

The Montreal Rolling Mills Co., Montreal, is negotiating with Sydney, C.B., for encouragement to locate rolling mills in that town.

Work is being rushed on the branch line from the Kingston & Pembroke Ry. being built into the Caldwell mine at Calabogie, Ont.

The Rhodes, Curry Co., Ltd., Amherst, will build large work shops at Sydney, C.B. The company has already bought the land which is close to the junction of the Intercolonial and Louisburg Railways.

The Dominion Iron and Steel Co., Sydney, was advertising at the end of October for 250 men to mix concrete, 500 men on night work, 100 men to load scows, 100 horses and carts, and 50 carpenters.

The directors of the Hamilton Iron and Steel Company have decided to practically rebuild the furnaces and make other improvements at a cost of $50,000. When completed the furnaces will have a capacity of 250 tons of iron a day.

The Beaverton Express says that recently an experiment was made at Phoenix foundry in that town with peat made by the new compression system as a fuel for smelting iron. The Express reports the failure of the experiment, the fuel being too light.

The Nova Scotia Steel Co., New Glasgow, N.S., is building another smelting furnace. The large steel building will be extended some eighty feet to cover the new furnace and bring the steel traveling crane in connection with it. The furnace will produce 100 tons a day.

The work is progressing on the steel plant which is being built in Hamilton, Ont., near the smelting works; the construction is in charge of Clifford C. Smith, who represents the Wellman-Seaver Company, Cleveland. There will be two furnaces, each having a capacity of fifteen tons. The main building will be 144 feet long and 90 feet wide. The furnaces, which are open hearth, will use gas.

The discovery of iron on the line of the Rideau Canal in Frontenac and Leeds counties is no new thing, though considerable attention is being given to it. The old inhabitants in Lansdowne and neighboring townships still speak of Lyndhurst village by its old name of Furnace Falls, for there were iron works at that point nearly a century ago.

Application has been made for a charter of incorporation for the Canada Foundry Co., with a capital of $1,000,000. The company is composed of Messrs. E. B. Osler, M.P., W. R. Brock, W. D. Matthews, Wm. Hendrie of Hamilton, Fred. Nichols, T. W. Horn and W. H. Winslow of the Chicago firm of Winslow Bros. It is the intention to establish a foundry in Toronto, and later on another in the West, probably at Vancouver. All kinds of cast-iron work, including every branch of architectural work, will be turned out.

The concreting and brick work on the Dominion Iron and Steel Co.'s blast furnace No. 1 was finished October 6th. Work on the other furnaces was to be finished November 15th. McManus, Low & McManus, contractors, have been working day and night, an electric plant having been installed, but the cement for the concrete work ran out, and the work has gone behind. The contractors were supposed, when the ground was prepared, to average 800 yards of concrete per day. The area to be concreted is 25,000 yards. Two cars of cement were brought from Montreal, but the cost of transportation was too great, and so the work had to wait.

An important auction sale took place in Montreal, Nov. 1st, when the assets of the Londonderry Iron Co., Londonderry, N.S., were sold for the sum of $153,000 cash to interests represented by H. S. Holt, Montreal. The capital of the company, which was incorporated under a Dominion charter some years ago, was placed at a million dollars, divided into $400,000 preferred and $600,000 ordinary stock. The directors were: Lord Mount Stephen, Sir Chas. Tennant, Glasgow; A. S. McClelland, Glasgow; J. J. Greenshields, London, Eng.; A. T. Patterson, Montreal; Jno. Turnbull, Montreal, and R. McD. Patterson, Montreal. Some time since the company went into liquidation, and the property was placed on the market. The assets of the company, which have now been purchased, consist of about 30,000 acres of mineral land, town lots at Londonderry, N.S.; together with the plant and machinery now contained in the building and on the property of the company. The property known as the Chignecto colliery, and situated at Maccan, N.S., as well as all outstanding claims, unsold material, stores, goods, and any rights belonging to the company on the 25th of last September, are all included in the transaction.

F. H. Clergue, Sault Ste. Marie, who founded the great pulp industry at that place, is now organizing a $20,000,000 iron and timber and transportation company. This is the Ontario Lake Superior Company, which is being formed by the same capitalists who organized the Consolidated Lake Superior Company, with which it will be allied. The new company is to acquire the entire capital stock of the Algoma Commercial Co. and the Algoma Central Railway. It will thus, it is stated, acquire title to some 2,000 square miles of timber and mineral lands adjacent to the Canadian lands of the Consolidated Lake Superior Company. A railroad line is being built as part of the project, and 40 miles is to be in operation next year, from Michipicoten harbor, on Lake Superior, to two hematite iron mines, one of which is the Helen mine, owned by the Consolidated Lake Superior Company, in the Michipicoten range. The plan is eventually to extend the road 120 miles to connect with the Canadian Pacific at or near Misanabie. It is estimated that the company will handle during its first year 1,500,000 tons of ore for the Consolidated Lake Superior Company. Jas. Conmee, who has charge of the construction work on the railway, stated recently that 2,000 men were at present employed in connection with the company's projects. Half a million tons of iron ore were ready for shipment at the Helen mine, and there were ten millions in sight.

H. M. Whitney, at a reception tendered him at Sydney a couple of months ago, summed up the prospects contingent upon the establishment of the new iron works in these words: "I believe that the establishment of these iron works will be the means of introducing the town of Sydney to the length and breadth of the whole world. I cannot control my enthusiasm when I think of the future. The dormant energies of the country will be awakened. Here, right at our very doors, is the basic source of all prosperity. We know that on yonder spot all the elements that go to produce iron and steel, can be assembled cheaper than on any other spot on the face of the earth. We have limestone almost at our feet, immense coal fields right at hand, and magnificent iron areas within a few hours' sail from the centre of production. It has been demonstrated that Cape Breton coal is the best in the world for metallurgical purposes. The establishment of the iron and steel works signifies more than the works alone. Industries that depend upon the production of those metals are bound to follow. I have no doubt that there will be a gradual extension from one thing to another, and, unless I am greatly mistaken, before many years the production of this vast concern will stretch from the Atlantic to the Pacific, and the material manufactured be exhibited in all the marts of the world. To the province of Nova Scotia will be restored its old shipbuilding industry, for, when there is coalition in the manufacture of iron and steel, all industries depending upon these two metals must naturally prosper."

The iron mines of Belle Isle, near St. John's, Nfld., bought for $1,000,000 from the Nova Scotia Steel Co. by the Dominion Iron and Steel Co. are thus described by Elias Rogers, one of the directors of the company, in a recent issue of The Toronto Globe: The deposit is of peculiar formation and different from anything I have ever seen. The ore can be taken out more

cheaply than in any other mine that I know of, said Mr. Rogers. It is in the form of segregated cubes, which can be detached by the use of a crowbar, one man being able to pry off tons at a time. The only preparatory work necessary is to strip off from six inches to two feet of soil on the surface and by the insertion of a crowbar in the cracks which run vertically throughout the depth of the deposit the ore is pried off and falls into small cubes exactly in the condition we want it for smelting. All that remains to be done is to shovel the ore into the ore cars and ship it to the smelter. It is a high grade ore, the surface of the deposit at the workings has very much the appearance of a tiled floor. The seams are nearly horizontal, with a slight dip to the north. No. 3 seam, the seam at present being worked, is from eight to ten feet thick, and from where it outcrops to where it goes under the hill is perhaps 300 feet wide and three miles long. The ore is taken out so easily that no blasting is really necessary, although occasionally a cartridge may be put in several feet from the face of the working to loosen hundreds of tons at a time. This ore can be laid down at the smelter cheaper than is being done by any other mine in the world. The conditions for handling the ore could not be better. The natural formation of the island is perfect for the purpose of handling the ore at the least possible cost. The company from which we purchased had already constructed a first-class plant for handling the ore economically. There is a double track line running across the island and terminating at the loading pier. The cars are operated by means of an endless cable, to which they are gripped at distances of about fifty feet. The loaded cars going down grade help to operate the light cars going back to the mine by the gravity system. The cars are unloaded automatically into pockets, from which the ships are loaded. There is also a large pocket constructed in the rock, which will hold many thousand tons, from which the ore can be emptied by means of a conveyor in the bottom and running through to the pier. This will enable the company to continue mining and store the ore should there be any delay of vessels. The cost of the ore free on board vessels is about 30 cents per ton. The Dominion Iron and Steel Co. will handle 4,000 tons of this ore per day.

Electric Flashes.

C. H. Mitchell, C.E., and Guy Winn are preparing a report on a proposed power scheme at Bracebridge, Ont.

The Goderich Knitting Co., Goderich, Ont., has installed an 80-light incandescent plant, supplied by the Jones & Moore Electric Co.

J. Haynes, Brigden, Ont., has placed an order with the Jones & Moore Electric Co. for an incandescent lighting plant for his mill.

Clelland Bros., Meaford, Ont., are installing an electric light plant which they have bought from the Jones & Moore Electric Co., to light up the factory.

The Niagara Falls town council is considering the proposals of the Niagara Central Railway Company for the extension of that road and its conversion into an electric line.

The Niagara Falls Park and River Railway showed their appreciation of the work of the fire brigade at the power house fire by sending a cheque for $100 to the town council.

The Mack Machine Co., Belleville, Ont., is placing an incandescent plant in its works. The order for the dynamo was placed with the Jones & Moore Electric Co., Toronto.

There has been great delay caused in the power development works at Rugged Rapids, Ont., by the breaking away of the temporary dam. Supplies cannot be brought in till the temporary dam is in position. The contract calls for the completion of the works by December 1st.

Geo. Forbes, F.R.S., London, Eng., electrical expert; Clemens Henshell, New York, hydraulic engineer; Dr. Coleman Sellers, of Philadelphia, expert engineer and ex-president of the Niagara Falls Power Co., were recently at Niagara, in consultation with W. B. Rankine, secretary and treasurer of the Niagara Falls Power Co., regarding the development of power on the Canadian side.

The West Kootenay Light and Power Co. has ordered another 30-h.p. three-phase induction motor from the Canadian General Electric Co.

The Canadian General Electric Co. is furnishing the Montreal Street Railway Co. with 20 of its standard general electric 1,000 railway motors.

Bothwell, Ont., has made a considerable extension to the electric plant recently, the work having been carried out by the Canadian General Electric Co.

The Canadian General Electric Co. has received an order from the Summerside Electric Co., Summerside, P.E.I., for a standard 120 k.w. single-phase alternator.

E. W. Stickney, Esq., Newburgh, Ont., has decided to place an incandescent dynamo in his factory, the order for which has been given to the Jones & Moore Electric Co.

The Standard Chemical Co., Deseronto, Ont., has recently installed an electric lighting plant in its factories. The apparatus was supplied by the Canadian General Electric Co.

The Palmerston Carriage Co., Ltd., of Palmerston, Ont., has ordered from the Royal Electric Co. a complete lighting plant, consisting of a 100 light dynamo, switchboard and wiring.

Richardson & Sons, Bedford, N.S., have bought a complete electric lighting plant from the Royal Electric Co., for their factory. The Maritime Electric Co., of Halifax is installing it.

The corporation of Neepawa, Manitoba, has contracted with the Canadian General Electric Co. for a standard 75-k.w. monocycle alternator with switchboards, transformers and wiring supplies.

The Canadian General Electric Co. is installing two standard 45-k.w. multipolar generators for Tooke Bros., Montreal, together with switchboards, and three 15-h.p. direct current motors, and three 8-h.p. motors.

The Montreal Cotton Co., Valleyfield, Que., is continually increasing its power plant, and has just placed another order with the Canadian General Electric Co. for six 50-h.p. and one 100-h.p. induction motors.

Donnelly & Drum, Ottawa, Ont., have recently ordered from the Jones & Moore Electric Co., an incandescent dynamo. This firm have also received orders from three Quebec firms for incandescent dynamos during the past month.

A new electric company has been formed in Dutton, Ont., for the purpose of supplying light, heat and power to the corporation, merchants and residents of the town. The Canadian General Electric Co. is supplying all the electrical apparatus, transformers and wiring. The initial order is for a 30 k.w. single-phase alternator.

The town of Paris, Ont., is to have a second electric light company, W. H. Meldrum, with a number of local people, having formed a new company, and have purchased a complete outfit consisting of a Leonard-Ball engine and boilers, and from the Royal Electric Co., a complete "S.K.C." two-phase system, the dynamo having a capacity of 50 k.w.

The Trent River Paper Company, Frankfort, Ont., has placed an order with the Royal Electric Co. for a 40-k.w., S.K.C. two-phase generator with transformers and supplies. It is the intention of the paper company to not only light its own large premises, but also Frankford (one mile distant), Stirling (nine miles distant), and possibly Foxboro and Wooler (six miles distant). Work of excavation was commenced on the 27th of May last, and the fact that this month this company will be making paper is an evidence of the capability of the manager, Walter S. Miller.

Another large manufacturing business is being established at Sault Ste. Marie, Ont., which promises to reach vast proportions in the very near future. F. H. Clergue, president of the Lake Superior Power Co., has been instrumental in interesting American capital in the formation of the American Alkali Co., of which he is the vice-president. They purpose manufacturing caustic soda and other similar products under electrolytic processes, and the initial plant will require 1,000 h.p. for its operation. There has been placed an order with the Canadian General Electric Co. for three 300 h.p. specially designed generators to be direct connected to water wheels. The plant is expected to be in operation shortly.

The J. D. King Co. has decided to operate a portion of its Toronto factory by electricity, and has placed an order with the Jones & Moore Electric Co. for a 20-h.p. motor, and also a 6 h.p. for the elevator.

The Richmond Electric Co., Richmond, Que., has installed a second 75-k.w. "S.K.C." generator. It has also installed a number of two-phase motors from 5 to 15 h.p., that operate from the "S.K.C." system.

Since October 21st, Dundalk, Ont., has had its municipally owned electric light. The plant consists of Leonard engine and boilers, and an "S.K.C." 30-k.w. dynamo. The streets are lighted with incandescent lamps.

The steamer "Sardinian," which is to transport the Canadian contingent to South Africa, is well supplied with artificial illumination for "The Soldiers of the Queen." The Royal Electric Company, of Montreal, started to install a complete electric lighting equipment on this steamer, Saturday, October 21st, and turned over the plant, consisting of one 20 k.w. direct current generator with 325 lights installed, complete in operating condition, Thursday, October the 26th.

The following is a list of some of the motors sold by the Jones & Moore Electric Co., during the last month, which goes to show the growing popularity of their new type of machines: Littlejohn & Vaughan, Eakins & Ferris, H. F. Sharpe & Co., Atkinson Bros., Social Tea Co., two machines, making the third this year; Toronto Law Book Co., L. Sexsmith & Co., W. C. Hunt, McFarland, Gray & Southgate, two machines, making three this year; J. W. Dobson, Toronto Glass Co., M. & H. Peterson, L. M. Swawite, Toronto Show Case Co., Canadian Camera Co., all of Toronto; Queen's College, Kingston. Five machines have also been sent to Winnipeg, Man.

ACCIDENTS OF THE MONTH.

Edward S. Evans, who for eight years had charge of the shops of the Toronto Electric Light Co.'s works, died last month.

A. Ellis, an employee in the Fernie saw and planing mill, lost his life, October 27th, by falling on a circular saw. He was a native of Dobbington, Ont.

Water thrown on a fire in the Dominion Carbide Co.'s works in Ottawa, caused an explosion which wrecked the building, and seriously injured 15 men.

Nicholas Milburn was killed, October 13th, at Nanaimo, B.C., while working in Protection Island shaft, his face and head being crushed by a fall of coal.

Peter Wiese, Chandos, Ont., was killed in an explosion at a gold mine near Apsley, in North Peterboro'. Another miner, named Galbraith, had his eyes blown out and one hand and the fingers of the other hand blown off, which caused his death.

H. M. Innes and H. Doley, prospector, were drowned while prospecting for gold at Windermere, B.C. Two other miners named James Mills and Charles Crane were killed about the same time at Moyie Bay by a premature blast in Lake Shore mines.

A man named L. Giguere, aged 26, employed at Howard & Craig's sawmill, Beauce, Que., was at work running a bark peeling machine, when in stepping around it he slipped and was thrown against the frame with such force as to break his skull, and he died in a few minutes.

John Atkinson, Toronto, 32 years old, employed by the Great Northwestern Telegraph Co., as lineman, accompanied by James Grasby, St. Chrysostome, Que, 26 years old, a blacksmith by ocupation, were drowned in Little Wolf Pond, near Ogdensburg, N.Y., October 17th.

A freight train from Madawaska to Depot Harbor, Ont., on the Canada Atlantic Railway, ran into a landslide at Rock Lake station, October 18th, as a result of which fireman Homer B. Barney, Jericho, Vermont, was killed, and engineer Arthur Grogan, of Depot Harbor, injured.

G. A. Sampson, of the Aikenhead Hardware Co.'s staff, while assisting in the cutting off of a piece of cast steel in the iron store department of the firm, was struck in the wrist by a particle of the steel which embedded itself in the bone, and had to be located by X-rays before the surgeons could remove same. Mr. Sampson has been particularly unfortunate, and had scarcely recovered from a severe operation, and it came very hard on him in his rather weakly condition of health, especially as there was great danger for a time that he would lose his arm.

Wm. Partlo, an Ingersoll, Ont., miller, had a narrow escape from a horrible death a short time ago. He was superintending the remodelling of King's mill, when he fell down the wheel-hole, alighting on the pipe which goes to the wheel, and thence falling into the water below. The wheel was running at the time, and had he fallen a few inches either way he would have been ground to pieces by the machinery. He was partially stunned by the fall, but had sufficient strength left to raise himself out of the water, and he was rescued from his perilous position as quickly as possible and medical aid summoned. An examination revealed the fact that no bones were broken, but he sustained severe injuries to his back.

An accident occurred at the cement works, Napanee Mills, Ont., Oct. 25th, by which George Thompson, aged 18, lost his life. He and H. Sweet, a lad about his own age, were alone at the time. Sweet for some reason flung a cement sack over a shaft making over 200 revolutions per minute. According to Sweet's testimony, Thompson asked him how they would get the bag. Sweet replied, "It will have to stay there." Starting to go about his work, he noticed where the sun was shining on the opposite wall a shadow flying around. Turning his head he saw Thompson on the shaft. As soon as possible the machinery was stopped, and Thompson's lifeless body dropped to the floor, horribly mangled.

PETROLIA AND THE STANDARD OIL CO.

Editor CANADIAN ENGINEER :

Your article in a recent issue of your publication was a gross misrepresentation of the facts as they exist in and around the town of Petrolia, and while the information may have been furnished you from a source which you presumed was authentic, the intention of the originator of the ghost story was clearly to injure a prosperous town from some spiteful or selfish motive. True, Petrolia has lost its refining industry, and with it a certain percentage of population, but Petrolia was a good town when this department was located chiefly in London, and other centres outside the oil producing territory. The last twelve months have seen more improvements in the town than any equal period for some years. Granolithic sidewalks are being constructed extensively, and a great amount of building is being done, including business blocks and a very large and expensive church. Merchants report business as good as any season they have had, and collections prompt. The real prosperity of Petrolea has always depended on the production of crude oil, and to-day there are very few idle drilling rigs in the territory. As a matter of fact Petrolea was never asked to bonus the Bushnell Oil Co., and further, when the Bushnell Co. purchased the refining plant of Fairbank, Rogers & Co., it was well known that they were a branch of the Standard. The Canadian oil trade had nothing to fear from the Standard or any other corporation, so long as the Government could withstand the inducements that American capital was prepared to offer in return for certain favorable concessions, the chief of which was the privilege of importing oil into Canada in tank ships and tank cars, and certain minor changes in the tariff and inland revenue restrictions. The present Government gave the Americans all they asked, and the Standard then quietly and in a business like way purchased all the refineries in Petrolea, and closed them up, and located the entire refining industry at Sarnia, as they must necessarily have their works at a lake port to take advantage of the tank ship concessions. You will now find oil being carried in tank ships owned by the company to points all along the lakes and St. Lawrence routes, at a loss of thousands of dollars freight to American railways. As to what the Standard will pay producers for crude oil in the future one cannot say, but to-day they are paying $1.62 per barrel for what was selling at $1.40 per barrel when they assumed control. They can pay as high for crude as is required, as they have control of the market in the refined product, and can advance the price of refined oil in proportion to what they are paying for crude (or more so). Petrolia may have lost some industries, but it has always been so far ahead of other similar towns in the West, that even with these industries gone,

it is still one of the best towns to be found anywhere, and you will see no grass on the streets, and no lack of business and enterprise, in proof of which note the fact that they passed this week a bylaw with only eight dissenting votes, giving franchise to a company to put down deep wells for gas and install plant, etc., for heating and lighting.

November 4th, 1899. PETROLIAN.

SIR WM. MACDONALD'S GENEROSITY.

Prof. Robertson, Dominion Commissioner of Agriculture, delivered an address before the Ottawa Public School Board, November 2nd, on the subject of the introduction of manual training into Canadian schools. At the close of the address he said: Sir Wm. Macdonald offers to pay for the equipment required for educational manual training in one place in every province in the Dominion, and also to meet the expenses of qualified teachers and incidental maintenance for three years in all those places. In Ottawa, he offers to equip and maintain for three years as many centres as are required to give all the boys (about 1,000), between the ages of 9 and 14 in the Public schools an opportunity to receive this training. It is hoped that after a year or two an equally valuable course of practical instruction, suited for girls of the same ages, may somehow be provided, and doubtless nature studies in rural schools will be joined to them. In Ottawa the plan will, incidentally, provide for evening classes for those actually engaged in trades who need and want technical instruction. Sir William has authorized me to make a similar offer to the school authorities of Brockville, Ont., of Charlottetown and Summerside, P.E.I., of some places in the province of Quebec, of Truro, N.S., of Fredericton, of Winnipeg, Man., of Calgary, N.W.T., and of some place in British Columbia. To begin it on right educational lines a thoroughly trained and experienced teacher of high attainment will be brought at first from Scotland, England, or the United States. Next summer it is proposed to pay the expenses of several teachers from Canada in Great Britain and Sweden to take the course of training there, to see for themselves the educational systems and methods of those countries and to meet teachers and other education reformers in them. When those Canadian teachers return they will be as lights set on hill tops. The fire of their inspiration, information, and enthusiasm will spread. Such in brief outline is the proposal I have the supreme satisfaction and happiness of announcing. It must result in immediate, lasting, and far-reaching benefit to the boys of Canada. I am sure we all join in the earnest hope that Sir William C. Macdonald, the wisely patriotic and generous benefactor, may long live, gladdened by knowing that the children and the grown men and women of Canada rise up and call him blessed.

FIRES OF THE MONTH.

Oct. 4th. St. Matthew's church, North Sydney, C.B.; loss, $12,000.——Oct. 6th. Taylor Bros.' sawmill, near Port Elgin, N. B.; loss, $4,000; no insurance.——Oct. 6th. MacPhee & Meader's flour mill, Moulinette, Ont.; damages, $4,000; insurance, $1,500.——Oct. 9th. The buildings at Fort Lawrence, N.S., of the Chignecto Ship Railway, which were erected during the construction work.——Oct. 16th. N. Levinsen's sawmill, Lake Megantic, Que.——Oct. 18th. Elgin's tannery, London, Ont.——Oct. 18th. F. H. Manning's sawmill and barrel factory; loss, $5,000.——Oct. 19th. Murray's planing mill, Winnipeg; loss, $12,000; partly insured.——Oct. 19th. Grist and sawmill belonging to D. Purriston, near Richmond Corners, N.B.——Oct. 25. The Fulton Bros.' sawmill, Fingal, Ont.; loss $5,000; no insurance.——Oct. 27th. Kennedy Bros.' evaporating factory, Leamington, Ont., loss, $2,000.

—Granville C. Cunningham has been appointed manager of the Central Electric Railway, London, Eng.

—F. W. Draper, B.Sc., of Rolla, Missouri, has been appointed lecturer in Metallurgy in McGill University.

—We have received a pamphlet of 250 pages, being the Proceedings of the Illinois Society of Engineers and Surveyors, 1899, a report of the fourteenth annual meeting held at Champaign, Ill., in January last.

—The Marine Review, Cleveland, O., issued a special number in honor of the return of the United States Admiral from the Phillipines, which contains a large number of very fine pictures of the ships of the United States Navy.

Recently the Boston and Maine Railroad began to sprinkle oil over its tracks to lay the dust, having constructed two special cars for the purpose. About fifty miles of track was covered the first day, and the sprinkling will continue until the entire system in the vicinity of Boston at least is covered. The oil costs 8⅝ cents a gallon, and the cost of sprinkling per mile is $6,250. After three annual sprinklings the oil will remain effective for from three to four years. Hereafter, when renewal of ties are made, or other disturbance of the road bed is called for, the overturned earth will be oiled from huge tin pots with flattened nozzles.

WANTED—Draughtsman, thoroughly competent man. One accustomed to engine and saw mill work preferred. WATEROUS, Brantford.

WANTED—Young man familiar with installing and repairing electric recording meters. Give particulars of experience. Only hustlers and first-class penmen need apply. Advancement if satisfactory. Address "WATT," Canadian Engineer, Montreal.

FOR SALE

A good Water Power, 500 horse, situated one-half mile from railway, every facility for making siding to power. Address

I. D. THEUNISSON, Cookshire, Que.

Levis Waterworks.

Notice to Engineers.

"A by-law opening a competition for the preparation of plans and specifications to establish a system of waterworks, draining and electric lightning in the town of Levis" has been adopted at the meeting of the council held on the 16th October, 1899.

Moved by Mr. Councillor D. Laine, seconded by Mr. Councillor Joseph Carrier that the by-law opening a competition for the preparation of plans and specifications to establish a system of waterworks, draining and electric lighting in the town of Levis be adopted as follows, viz:

1. A competition is hereby opened to all competent persons, to prepare plans, specifications and estimates, for the establishment, execution, working and maintaining of a system of waterworks draining and electric lighting in the town of Levis.

2. The persons wishing to take part in the said competition can obtain the necessary information and particulars on inquiring at the Secretary Treasurer's office, at the city Hall, Levis.

3. The plans, specifications and estimates will have to be prepared so as to provide for the supply and wants of a population of twenty thousand souls at the rate of thirty gallons of water per head, every day.

4. The plans and tenders for the above mentioned purposes shall have to be deposited at the office of the corporation of Levis, on or before the first day of January next.

5. Those plans and tenders will then be submitted for examination to three competent persons chosen by the council, and the said persons shall report to the council within the delay fixed by the said council.

6. The council, nevertheless, will have right to choose and adopt whatever plans and tenders which it will deem most advantageous, and will not be held to accept those whose price will be the lowest or any of them.

7. A prize of $1000 will be awarded to the person whose plans, specifications and estimates shall have been declared the best by the three persons mentioned in article fifth of the present by-law; a prize of $500 to the person whose works will come in the second place.

8. These plans, specifications and estimates shall remain the property of the corporation of the town of Levis

FLAVIEN ROY, Secretary-Treasurer. J. EDMOND ROY, Mayor.

American Sewage Disposal Co. of Boston

89 STATE STREET, BOSTON, MASS. 60 BROADWAY, NEW YORK.

JOHN N. McCLINTOCK, A.M., C.E., President & General Manager

The Company is organized to design and construct sewers, and to build sewage disposal works (protected by patents), effecting any degree of purification required, under all climatic conditions. Circular sent on application.

We invite investigation, consultation and correspondence

The Canadian Engineer

VOL. VII.—No. 8. TORONTO AND MONTREAL, DECEMBER, 1899. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.
OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR, R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE.

Toronto Telephone, 1392. Montreal Telephone, 2589.

UNITED STATES AGENT:
H. E. BURNETTE, Cor. Fourth and Locust Sts., Philadelphia.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent wherever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Accidents of the month	209
Acetylene Lighting, Progress of	214
Building, the Tall, Under Test of Fire	218
Catch-Basin, The Robertson	230
Catalogues, New	232
Cement, Some Experiences with Portland	237
Coke from Nova Scotia Coal for use on Railways	231
Civil Engineers Canadian Society of	230
Draught, A Test of Mechanical	229
Electric Flashes	234
Engine, The Peerless Self-Oiling Automatic	224
Fires of the Month	232
Gas Engine, General Principles of	226
Generating Set, A Substantial Type of Marine	222
Heating	236
Iron and Steel	236
Industrial Notes	233
Literary Notes	231
Metal Imports from Great Britain	237
Mining Matters	236
Mineral Wealth, Newfoundland's	221
Ontario, A New	213
Personal	237
Philosopher, An Impoverished	224
Practical Man	232
Railway Matters	236
Sawdust, Destructive Distillation of	213
Schools, The International Correspondence, in Toronto	229
Smoke Nuisance, The	221
Steel, The Manufacture of, for Building Construction	225
Steel, Overstrain in	223
Stationary Engineers, Canadian Association of	231
Turbine Steamer, The	229
Watermain Scraping	231
Witwatersrand, Milling the Gold Ores of the	215
Yukon, A Trip to the, in 1905—A Fancy	xix.

SOUTH AFRICA, ITS PEOPLE AND TRADE.

CAUSES OF THE BOER WAR.

ARTICLE III.

To give an idea of all that has been suffered by the Uitlander population of the Transvaal would be impossible in so brief a sketch as this, but a few of the grievances may be stated. First stands the franchise. As already mentioned, when the internal independence of the country was granted in 1881, it was, of course, believed that all white races would be treated alike, and Kruger, in the most distinct manner, promised this. The franchise was at first to be given on a property qualification or upon one year's residence; but in order to cut off those who came in after the annexation, the Volksraad (Parliament) afterwards changed this to five years, and then when time passed by and the five years' citizens looked to the time of enfranchisement, the law was again amended so that a man had to be a constant resident in the country for fourteen years. When the conditions were looked into, it was seen that even when the fourteen years should have elapsed, the Uitlander would not get his vote, because the claim had to be based on the field cornet's records, and in nine cases out of ten, there were no records of the registration. In many cases the field cornet could not read or write, and in cases where he could, there was a temptation to neglect the duty. In a majority of cases he collected the taxes without making any returns, so that the omission of the names gave no record of the fraud, thus serving the double purpose of concealing his stealings and depriving the Uitlander of his vote. But even if this were honestly carried out, the Uitlander was further discouraged by the provision that he should first have to renounce allegiance to his own country, remaining a political eunuch for these fourteen years, and then when this time expired, he would have to get the recommendation of a majority of the burghers of his district (whom he knows to be hostile), and still after that his application is liable to the veto of the President and Executive. We see the pitfalls so artfully prepared, in order that a man would certainly fall in one if he escaped another. Can it be wondered at that the High Commissioner and the British Government wanted to make sure of the details of the recent proposals made by Kruger at and since the Bloemfontein conference? As President Kruger is a great reader of the Bible, it would be curious to know what he would have to say to the franchise provisions laid down in the 47th chapter of Ezekiel, verses 21 to 23? The Montreal "Witness," in pointing out this principle of Old Testament law, remarks that "the most curious thing in Boer legislation is that they should by special enactment exclude from participation in the land and liberty they enjoy, the very people to whom they are indebted for the Scriptures they prize so highly, and who, even before the Babylonian captivity, extended to the stranger, who came among them, the benefit of the ancient ordinances. This instance, however, only goes to confirm the estimate made of the Boers by Dr. Livingstone, who described them as narrow, stupid and cruel."

The Boer Government not only excludes both Jews and Roman Catholics from the franchise, but even from working in the civil service. If it is found out that a railway, post office, or other civil servant is a Jew or Catholic, he is quietly but speedily dismissed, and a Boer, Hollander, or German appointed to take his place. The Germans and Hollanders would, however, not be called in if it were not that very few Boers are sufficiently educated to fill these places.

By the trickery and breach of faith before described, the voting-power was kept, as before, in the hands of the Dutch burghers. As not one out of a thousand of the Boers of the rural districts had enough education to fill civic offices of responsibility, many Englishmen held public posts for a time after 1881, but one by one these were dismissed and Hollanders and Germans imported to take their places, until British subjects were almost as completely shut out from all share in the civic life of the country, as they were from political influence. One of the first fruits of this oligarchic rule was the system of plunder by concession. Each session of the Volksraad brought a horde of speculators, who purchased by bribery the sole right to manufacture or sell this or that article in the Transvaal. These mono-

polies, or "concessions," were secured chiefly by Hollanders and Germans, and hence, we see one mainspring of the active sympathy of Hollanders and Germans in the present contest, for between the fat salaries of the imported officials, and the dividends from the operation of the monopolies, a good stream of money has been flowing into Holland and Germany for some years past. When we consider this, and the extortions of the Netherlands Zuid Afrikan Railway Co., owned and managed by a group of Hollanders, and when we consider that by every device possible, British trade is hampered and Dutch and German imports favored, we see why the cause of the Boer should be so warmly espoused in Holland and by sections of the German press, even if race affinity were not a factor in the case. We may add to this the work of the Transvaal political agent in Europe, Dr. Leyds—a Dutch pocket edition of Talleyrand—who has been supplied with means to make the agency a nest of intrigue against Great Britain ever since his appointment. The Netherlands Railway Co. has practically controlled the finances and legislation of the State. It has been able to levy the outrageous freight rate, averaging 8½d., say 17 cents per ton per mile, as compared with 6 cents per ton per mile on the Cape and Natal railways, which themselves return a good dividend to their governments. Yet, when some of Kruger's own friends protested against these extortions, he said he considered this contract a matter of high policy, and would not even hear the subject discussed.

The art by which the combined Boer and Hollander legislators framed laws, which, while appearing to the outside world to be quite fair, yet could be made to work out to the particular disadvantage of the Uitlander, amounts to a positive genius. For instance, the school laws, while apparently giving a show to English children, are so worked as to school hours, etc., that in practice English children can neither get a chance to learn English or Dutch, while the school tax is so artfully fixed that the English parent, whose child is robbed of its chance of education, has to pay £7 against the Boers' £5. A law, to forcibly suppress all English private schools even, was proposed in the Volksraad, and only defeated by two votes. The school law is so beautifully arranged, in the case of Johannesburg, that the grand sum of £650 a year is spent on the children of Uitlanders, who have to pay nine-tenths of the £63,000 spent on education there. Then there is a tax of £20 recently levied on farms. Here the unsuspecting foreigner would see a tax levied on the Boer element entirely. Kruger cannot be so unfair after all. But look at it a little closer, and you will notice that farms on which the proprietor lives are exempt; look still closer and you see that it applies to farms owned by companies only. Now the Boer never buys stocks or bonds, and never goes into partnership, so you see it hits the Uitlander, who has bought up a Boer farm at five or ten times its agricultural value, on the chance of minerals being found on it. Another example of Boer "slimness": A poll-tax was recently introduced. It was to be levied on all male inhabitants, and there was no distinction or discrimination. Surely this was fair to all? Time answered the question in the same old way, when it became known that the tax of 18s. 6d. was faithfully collected from all Uitlanders, but not one Boer or Hollander has ever been made to pay. These are just a few samples of Krugerite equity.

We are familiar with the press law, by which Kruger has imprisoned and brought financial ruin on editors who have had the courage to run up against him. Of the same brand is the law giving it into the discretion of a policeman to break up a meeting, in the open air, of more than seven persons.

If the torture and degradation of thousands of Englishmen, Americans, Australians, and other peoples, accustomed to free institutions, were not in question, it would be amusing to those knowing the facts, to observe the injured innocence which glowed in the official despatches of the Boer Government right up to the time of the ultimatum. "If these people," said one of these despatches dealing with the petition of 40,000 Uitlanders made direct to the Queen, "instead of complaining to the British authorities had only come to this Government direct, their complaints would have had attention." What had they been doing all these years but complaining to a Government which treated their entreaties with scorn and contempt and only changed the chastisements by whips for those of scorpions? In 1893, a petition for the redress of grievances, signed by 13,000 Uitlanders, was presented to the Raad, and was received with a general laugh of derision. In 1894, another petition, praying for reforms, and signed by over 35,000 adult male inhabitants, was presented, and received more seriously, and it is due to some of the Dutch members that they made a stand for fair play; but the only response from Kruger, who moulded the Executive at his will, was new restrictions on the Uitlander's liberty, and new burdens on his industry. When the vote was taken on this petition, one of the Boer members was heard to say: "Nothing can settle this but fighting, and there is only one end to the fight. Kruger and his Hollanders have taken away our independence more surely than Shepstone ever did." It is only fair to say that many members of the Raad, who might be called progressive, by comparison, saw what Kruger's policy was leading to, and urged concessions to the Uitlander element. These were supported by a slowly-growing minority of burghers, who were almost as jealous of the Hollander faction as they were of British. But Kruger had his will; and when he found occasions arising where he could not carry his point by straight legislation, he went past the Volksraad and did it illegally, as head of the Executive. On several occasions he upset the decisions of the High Court, and ended by forcing the resignation of Chief Justice Kotze, who refused to prostitute the court, and make it the tool of the Executive. A more pliant man was put in his place, and Chief Justice Kotze was deposed without a pension or other allowance or support to his old age. A sample of the direct and easy way in which the Government overrode the decisions of the courts was furnished by the Doms case, among others. A man named Doms sued the State, but while the case was pending, the Government passed a resolution declaring that Doms had no right to sue! And so Doms was thrown out of court, lost his property, and is now a cab driver in Pretoria. When the Government wished to defeat the ends of justice, even in the High Court, all it had to do was to declare itself by resolution, and it was done whether the resolution conflicted with the

grondwet (constitution), or not. It is scarcely to be wondered at that the Uitlanders lost all hope of fair play when such things could be done.

(to be continued).

For The Canadian Engineer.

DESTRUCTIVE DISTILLATION OF SAWDUST.

A series of experiments have been made in Ottawa in October with a machine for the destructive distillation of sawdust, which is designed not only to get rid of the dust, but also to turn it to financial account. These runs were eminently satisfactory, exceeding even the expectation of those who knew most about the machine. Much has been written, and more said, about machines designed for the destructive distillation of sawdust and the products therefrom, but many difficulties have to be overcome before the desired object can be achieved. Sawdust offers so much resistance to the passage of heat through a mass of it that it is necessary to bring successive quantities of dust in contact with the heated plates, or to bring a mass successively into contact with the plates of the retort.

The machine referred to may be described as a cylindrical retort, to the ends of which are bolted flat castings, in the centre of which are holes to allow of the introduction of a short but large hollow shaft. On the outside of the end castings are stuffing boxes and glands to prevent gaseous and liquid matters escaping. Through the end openings pass the shafts, which just clear the end castings and then spread out to form four arm spiders which are bolted to a drum. In the centre of this drum and extending its entire length is a tube which is rigidly fastened to the end spiders.

In the spaces between the tube and the drum, and between the drum and the shell, are arranged plates which encircle respectively the tube and the drum, one forming a right hand and the other a left hand helix or conveyor. This arrangement ensures a continuous circulation of dust through the machine. The machine is fired in a way specially designed to maintain an even temperature throughout. No direct fire is allowed to come into contact with the shell. The machine is carried by lugs in an oven, the hot gases from which pass through the tube above referred to, thereby providing a large internal heating area ; from this tube the gases pass into the chimney

Charging is accomplished through an opening on the upper side of the machine, and the discharge is situated at the bottom or underside, and at one end, and is automatic. It is perhaps hardly necessary to state the nature of the products, but it may be interesting to some who may not have a knowledge of chemistry to know that destructive distillation is a process—broadly described as the decomposition by heat in a closed chamber, of a body the elements of which recombine, on cooling, to form compounds differing chemically and physically from the parent substance. When sawdust is submitted to this process it breaks up into bodies widely different from one another and from the parent substance. These bodies are principally pyroligneous acid or crude acetic acid, wood oils or wood creosote, tar, naphtha, or pyroxalic spirit, a large quantity of combustible gases, mainly carbon monoxide, and a residue of charcoal dust which is unequalled as a form of carbon for the manufacture of calcium carbide, showing as it does 98.95 per cent. carbon and only 1.05 per cent of ash. There are in addition to the above, smaller quantities of furfurol, acetone, methyl acetate, ammonia, etc., formed. The chemistry of these products is interesting and offers several alternatives in the methods of preparation for the market.

Although the machine was a proved success nearly a year ago it has been difficult to obtain reliable information in regard to it, as those interested were anxious to be disabused of any doubt as to the details and financial standing such machines would establish for themselves.

Patents have been granted in the U.S.A., Canada and nearly all industrial countries.

The machine has been tried in the utilization of other than mill refuse, but in this respect nothing will be stated till arrangements, mechanical and commercial, have been completed. This invention will be received by the public as a boon, effecting as it will a considerable, if not complete abatement of the sawdust nuisance. The interested parties have wisely avoided anything being printed until the machine had been proved in the presence of one of the largest lumbermen in the country.

The inventor of the machine, who at present desires to remain unknown, is also at work on a new method for the production of acetylene at a cheaper rate than is now possible, and hopes to be able to use the carbon from the machines whilst still hot.

A NEW ONTARIO.

It would appear that Ontario is about to come into her own. The courts have just sustained the Government in the matter of the manufacturing clause in the timber licenses, and in future the forests of Ontario will not be cut down solely to create United States millionaires and Michigan saw-mill cities. We will have saw mills of our own which will supply the United States consumer, and the millionaires will be cultivated to the north of the international boundary.

On the day that the decision of the court was handed down in the appeal case of the United States lumbermen, already referred to, the Hon. G. W. Ross, the new Premier of Ontario, announced a somewhat similar policy with regard to the nickel-copper bearing ores which, we have often pointed out in The Canadian Engineer, are one of the chief sources of wealth of Ontario and, indeed, of the Dominion of Canada. All mining licenses of nickel-bearing lands granted in future in Ontario will contain a clause prohibiting the export of the ore or matte, and permitting the export of refined nickel only. The Government would take power, also, if deemed expedient, to restrict the operations of the holders of existing licenses in the same way. It also appears that the Ontario Government has for over a year past been endeavoring to interest the Imperial Government in the use of nickel steel armour plate for the royal navy, and that there is a possibility of the Imperial Government assisting in the establishment of works for its production.

We do not wish to add ourselves to the stately procession of influential journals which, in a couple of days following Mr. Ross' announcement, each claimed that it had forced the Government to take what must, on all sides, be conceded as a splendidly advanced position. We are satisfied to point to our discussion of this subject, which has been widely quoted throughout the country. The Canadian Engineer wishes to offer its most hearty congratulations to the new Premier of Ontario for the work he is doing in developing our great country; we hope that we may soon be able to offer similar congratulations upon the settlement of the Niagara power question (which still needs to be settled), so that the greatest possible amount of power may be supplied to the largest number of

users and the greatest possible share of the profits be divided among the people of Ontario—not among the members of the Government.

The policy of the new Ontario Ministry on the nickel question is in fine contrast to that of the Dominion Government which—in spite of the protests of individuals of its own party—has played into the hands of the foreigu corporation which has held a monopoly of our nickle industry in a most questionable manner.

PROGRESS OF ACETYLENE LIGHTING.

A recent number of the Canadian Electrical News contained a table, attributed to a committee of the Canal dian Electrical Association, purporting to show the position of acetylene lighting in Canada. This table was compiled from replies received in response to circulars in which a series of questions was asked as to the number of generators installed, the number discontinued, the cause of accidents, etc. These circulars could only be sent to those who were known to have installed acetylene lighting plants. Unfortunately for statisticians a large number of people who receive such circulars never take the trouble to reply, and when this fact is taken into account, and the further fact that large numbers of business firms and private citizens have installed acetylene plants of which the compiler, could have known nothing, it will be evident that the table could be of very little value for statistical purposes. Indeed a footnote to this table states that it is "probably inaccurate as to the number of generators installed, the number in use, the capacity of light, the period of use etc." In other words, the compilers make the Canadian Electrical Association responsible for putting forward a table of figures which they admit to be inaccurate in every detail, including the "etceteras," which are supposed to comprehend the comments of those correspondents who reported. According to these tables there were installed in Canada last year 217 acetylene lighting plants, of which 62 had been thrown out, leaving 155 in use, and in 30 of these installations accidents were reported. Even if these returns were complete, a moment's reflection would show the inadequacy of the record. Every gas company and electric light company knows that a certain proportion of customers change their house and store lighting, throwing out one system and putting in another, or they discontinue their light by reason of removal to another place, but these changes, which are constantly going on, are no argument against either gas or electricity as an illuminant. Then as to accidents, the wonder is not that there were thirty accidents (the period of time in which these occurred is not stated), but that there were not three times that number. We must reflect that practically all these acetylene lighting plants were isolated ones; so that to make the comparison fair we have only to imagine that gas lighting had just been introduced when acetylene lighting was tried, and that each house was lighted by a separate generator as in the case of acetylene. Assuming that as little was known of the nature of gas as acetylene, we could then imagine how the record of accidents would compare.

The apparent purpose of these statistics was to show that acetylene was making no headway as an illuminant. That this conclusion is hardly justified may be deduced from the fact that the world's output of calcium carbide (the source of acetylene gas) has grown from a few thousand dollars annual value in 1895-6 to the value of $19,228,300 in 1898, the quantity of carbide being 282,380 tons. The countries principally producing this are the United States, Canada, Germany, France, Italy and England. As far as most countries are concerned, including Canada, the difficulty with the users of acetylene is that the supply of carbide has not kept up with the demand, and many people have had to give up actylene lighting simply because they cannot depend on getting the carbide. This deficiency may soon be remedied in Canada by the establishment of such works as those now being established by the Bronsons at Ottawa, which will be prepared to turn out 15 tons a day in the spring and will later on produce about 30 tons a day. The firm of A. Holland & Son, of Ottawa, who deal in calcium carbide, showed a representative of this journal orders from many foreign countries, some of them requiring a supply of several tons per month. These orders Mr. Holland has had to turn away because he could not guarantee the supply of carbide. The same difficulty is experienced at the Willson Carbide Works at Merritton. There is plenty of room in the industrial world for all three illuminants, and certainly the demand for calcium carbide for the production of acetylene gas is quite remarkable.

—F. G. Moon, Ottawa, an employee of the Post-Office Department, has invented another roller boat. A large working model has been built and a futile attempt was made a short time ago to make it roll. Like other roller boats, however, the trial of the model reveals a number of problems which the inventor had not taken into account. The roller principle of navigation has been tried in many places in Great Britain, Europe and the United States, but judging by its past records it is not likely to prove a success, except possibly for the navigation of sheltered rivers having a quiet current.

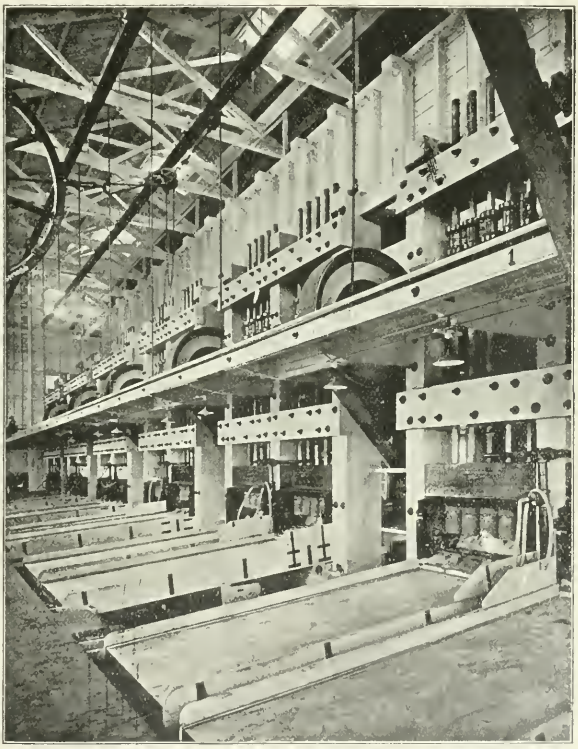
—The Bricklayers' and Masons' Union in Ottawa has passed a resolution condemning the proposed introduction of technical instruction into the public schools of Ontario. That such an act of folly should be succeeded the next week by a resolution of the executive committee of the Canadian Manufacturers' Association opposing the introduction into Canada of the metric system is almost enough to justify those amongst us whose croakings about the smallness of our industries and the hopelessness of their competition in the world's markets, at last have nearly been put to silence by the rattle of machinery in our overworked factories. The Manufacturers' Association has estimated that the introduction of the metric system would cost $2,000,000. With their all-sufficient wisdom these good people fail to offset this sum by the foreign trade of Canada, of which we stand in danger of losing a large part if we adhere to our present clumsy system. The metric system is simply applying to weights and measures the advantages we have in our monetary system. Would any Canadian discard our decimal system of money and go back to the "*old* Canadian currency," or the sterling system of coinage? As we realize the simplicity of the decimal system of money so we would see the immense gain in time and convenience in the adoption of the decimal or metric system of weights and measures. When even in conservative England a body like the Associated Chamber of Commerce, representing the crystallized opinion of the great commercial associations of the Kingdom, pronounces so emphatically on the necessity of this reform in order to save British foreign trade, we may realize that it is a change which must come. With ourselves it is only a question whether we or the United States shall be first in the field, for the latter country is now agitating for the change and has commenced an educational propaganda with that object. As to the Ottawa labor unions who wish their children to grow up without technical education in the schools, they should remember that when the steam

engine was introduced, it was their intellectual ancestors, was it not, who denounced and fought against that invention as a devilish machine which all pious laborers should destroy to save their children from starvation?

MILLING THE GOLD ORES OF THE WITWATERSRAND.*

The mill, in Witwatersrand practice, is but the first stage in the general metallurgical process, preparing the ore not only for its own treatment, amalgamation, but for the second step, the cyanide process, for it must be remembered that, but for the cyanide process, a very small percentage of the mines on the Rand would pay, and that the industry as a whole owes its salvation to this method of gold extraction. To examine the question of milling alone without considering the subsequent cyaniding of the tailings would produce a false impression, conveying the idea that the stamp practice on the Rand, in percentage of gold extracted, compares unfavorably with that of California or other places. The object is to get the greatest extraction at the least cost, by combining the two processes, the tendency being towards a high crushing capacity rather than a high extraction by amalgamation at the expense of crushing, relying on amalgamation for a fair percentage of the catch, and increasing the extraction by the subsequent cyanide treatment. While it is usual on the Rand to amalgamate in the batteries, less attention is paid to the practice than is common elsewhere. The easily amalgamated gold is caught on the outside plates, and the more refractory portion is treated by cyanide. Coarser crushing would be the rule, were it not necessary, in order to secure the best results in cyanide treatment, to have the ore crushed fine. The first mill, a battery of five stamps, at which any of the banket of the Witwatersrand was crushed, was erected in 1885 by H. W. & Fred. Struben, about ten miles from the place where Johannesburg now stands, for the purpose of working quartz reefs. The following year several samples of conglomerate were crushed, the highest yield being 8 dwts. per ton. H. W. Struben, in an interesting letter dated January 17, 1893, says: "We milled conglomerates from Vogelstruisfontein, both for ourselves and for others, at our private mill, long before anyone else had a mill."* The state mining engineer's report for 1896 gives the number of stamps for that year on the Witwatersrand at 4,291, and the number of tons crushed at 3,980,682, the yield being £5,346,527, or an average of 26.36 shillings per ton. Including treatment by cyanide and chlorination, the total yield was £7,781,845, or 38.05 shillings per ton, and the average duty per stamp per twenty-four hours 4.392 tons. Eight hundred and sixty stamps have been dropped since 1896.

There are few mills of less than 60 stamps on the Rand today and those of 100 and more are in the majority. The tendency of the newer mills, for large claim area, is toward 200 stamps, those of the Crown Deep, Rose Deep, Nourse Deep, Jumpers Deep, and Robinson Deep having this end in view, while the new mill at the Simmer & Jack Proprietary Mines, Ltd., has 280 stamps erected and in place, and the combination mill of the Angelo and Dreifontein Con. mining companies, now nearing completion, is to have 220. The older mines on the outcrop have mills with 60 to 160 stamps.



60-Stamp Mill, Nourse Deep.—Stamps Grouped by Tens.

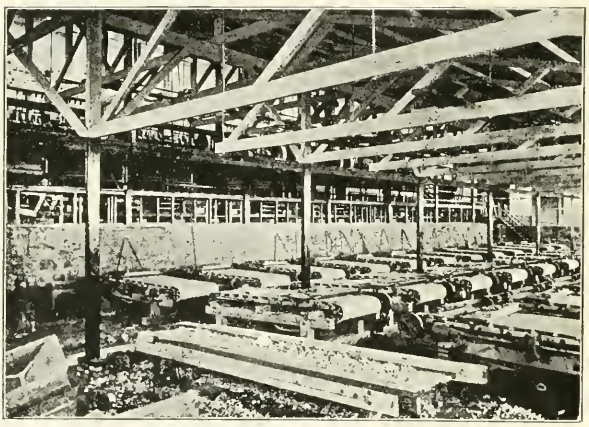
In the more recently constructed mills of the Rand the "banket" is delivered into the mill, after having been sorted and crushed, either at a central station or at stations at the shaft's mouth, and is fed from the ore-bins, by mechanical feeders, to the stamps, where, in the majority of the mills, a preliminary amalgamation takes place in the mortar box. The pulp flows over copper plates for further amalgamation, and in a few instances is delivered to frue vanners for concentration, the tailings going to the cyanide works; but the general practice of the Rand mills is to deliver the pulp direct from the amalgam plates to tailing wheels, or, sometimes, to pumps, to be elevated

*Abstracted from an article by H. H. Webb, and Pope Yeatman, in the Engineering Magazine.

**"Diamonds and Gold in South Africa," by T. Reunert.

to the height necessary for the requirements of the cyanide plant, a rough concentration by means of spitzluten being, as a rule, the first step preliminary to the cyanide treatment. Where frue vanners are employed, it is customary to use three for every five stamps, but, because of the heavy duty per stamp, they are often overloaded. The product from the vanners, being generally pyrites of high grade, is subjected to chlorination for the extraction of the gold. The mills are almost invariably placed near the mine rather than near the water supply. The building itself is framed with timber and covered with corrugated iron. Good foundations are put in, and the construction of the building is very strong. The timber is generally Oregon or pitch pine.

The ore bins are placed on strong masonry foundations, and are made of heavy timbers, well bolted together, the bottoms of the bins sloping towards the batteries at an angle of from 40° to 45°. In a few instances, as at the Simmer and Jack and the New Croesus, flat bottoms are used. Bottoms and sides are usually made of double thickness of 2-inch or 3-inch planks, with a lining of sheet iron. These bins hold from a day's run to four days' run. The feeders used are of the "Hendey Chal-



Arrangement of Frue Vanners in George Goch Mills.

lenge Ore Feeder" type, and are practically universal. There is no feeding by hand anywhere. The mortar boxes resemble the homestake pattern, the main differences being in the height of the feed opening and in the length and width of the boxes. Fraser and Chalmers and the Sandycroft foundry have supplied most of the batteries. As the stamp mills on the Rand are rather larger than the average, the mortar boxes, too, are larger and of greater thickness. At the issue the boxes vary between 11½ inches and 18 inches. Most of the mortars have heavy cast iron or steel linings in the front, back, and sides of the boxes, to ensure a longer life. Below the dies false bottoms of cast-iron are put in. Several thicknesses are often employed, to ensure uniformity of depth of discharge as the dies wear down. The mortars are placed on piles 12 to 15 feet in length, which rest on 1½ to 2 feet of concrete. The piles consist of heavy pine timber about 14½ inches square, and are bolted together firmly, both lengthwise and crosswise. The pile pits are excavated to hard rock, where possible. The walls of the excavation are built of heavy masonry or concrete, and the space between them and the mortar blocks is filled either with sand, or with tailings well rammed, or with concrete. Between the mortar block and mortar is placed a thick sheet of rubber or, occasionally, felt. The boxes are held down by eight bolts about 1½ inches in diameter, which at the lower ends are recessed into the wooden piles and are held by cotters. They are tightened by nuts on their upper ends. There is plenty of clear space about the batteries, and all bolts can be easily reached.

The screens are of well-woven iron or steel wire. The meshes range in number between 500 and 900 to the square inch, 900 being very common. The area of the holes ranges from .004 to .007 of a square inch. The life of the screen is very short, between two and three days on the average. The height of discharge in a battery is regulated by the use of chuck blocks as the dies wear down, or by having several sets of screens, which may be inserted from time to time. The width of the lower sides of these varies. The custom is to employ from two to three chuck blocks. There is a considerable variation in the height of the discharge. When amalgamation in the battery is considered an important feature, the discharge is raised; where rapid crushing is considered of more importance, a lower discharge is employed.

The first stamps employed on the Rand were considerably lighter than those favored at present. Stamps weighing from 750 to 850 pounds, the other parts being light in proportion, were used at first. In all the batteries now being erected, and in those that have been built within the last year and a half, the tendency is towards very heavy stamps, the weight varying between 1,100 and 1,250 pounds. The mills being erected under the supervision of the Rand Mines, Ltd., have stamps averaging about 1,150 pounds; those erected at the Simmer and Jack and at the Robinson Deep weigh nearly 1,200 pounds. Even with the old style of stamps, by adding extra tappets or putting in heavier heads, the weight has been increased, and, in consequence, the crushing capacity. According to the state mining engineer's report for 1896, the average weight of stamps was 973 pounds. In order to equalize the weight, it is the custom in some mills to use in one set of batteries heavy heads, and in another set lighter ones. New shoes are placed first in the second set, which, after being worn, are taken off and placed in the first. By this means the light heads always have the heavy shoes, and the heavy heads the partly worndown shoes.

Shoes are made of various varieties of steel, such as Chrome, Hadfield's Manganese, Firth's cast steel and forged steel, etc. They range in weight from 180 to 240 pounds. They are 8½ to 9 inches in diameter, and in height 9 to 12 inches. Heads and tappets are made of cast steel, the former weighing from 260 to 365 pounds and the latter from 106 to 130 pounds. Dies are 8½ to 9 inches in diameter and 6 inches high from the top of the 1 inch hexagonal bottom. They are made of Firth's, Hadfield's Manganese, or forged steel. Stems are tapered at both ends, and are made of fagoted iron. They range in weight from 350 to 475 pounds, and in diameter from 3¼ to 3¾ inches.

It is customary the world over to have five stamps to a battery. On the Rand two batteries are usually placed together, with a clear space of five to six feet between them and the next pair, each battery having its own cam shaft and separate driving wheel. In some cases one cam shaft and one driving-wheel serve for ten stamps. At the Simmer and Jack four batteries are placed consecutively, with two driving pulleys and two cam shafts. The plan of having one driving pulley for each five stamps is favored by the mill men, as the delays occasioned by necessary repairs affect a smaller number of stamps at a time. Cam shafts are made of fagoted iron, and range from 5 to 6½ inches in diameter.

Cams are made of cast steel, and vary somewhat in design

and in the manner in which they are attached to the shaft. The Blanton cam is deservedly popular; there are no keys, the cam being fastened to the shaft by means of a circular wedge, which is prevented from slipping by the short pins dropped into recesses in the cam shaft. This causes great saving of time in attaching cams and in replacing broken cams on the shafts. The George Goch has introduced for trial on one battery a cam which, instead of having a circular opening, has a decagon fitting on a cam shaft of the same section.

The drop of the stamps ranges from 7 to 9 inches, the average being about 8 inches. There is, perhaps, less variation in speed, this running from 92 to 104, the average being about 96. The order of drop is usually 1-3-5-2-4, although 1-4-2-5 3 and some others are employed.

The amount of water used in crushing ranges from 8 to 9 tons per ton of ore crushed. This does not mean that that amount of make-up water has to be supplied, as the water is used over and over again, the only loss being due to leakage, evaporation and absorption by the tailings. This loss, or make-up, is estimated at 25 per cent.

Apron copper plates are universally adopted. Inside the batteries both back plates and chuck plates are used, but the former are the most common. In some mills lip and splash plates are used. Apron plates are from 10 to 12 feet long, and from 4½ to 5 feet wide, and incline from 1 inch to 1¾ inches to the foot. Sometimes they are broken, but usually continuous. Back plates are from 7 to 11 inches wide, and chuck plates from 3 to 6 inches. The copper plate used is from ⅛ to 3-16 of an inch thick. They are rarely silver-plated, and, when a new mill starts up, considerable time elapses before the plates cease to absorb large amounts of gold.

One of the points of great difference in the Rand Mills is in the arrangement of the line shafts. These are either coupled directly to the mill engine or driven by rope-transmission. The latest mills erected by the Rand Mines, Ltd., employ direct coupling with the engine at one end. The new Simmer and Jack mill uses rope-transmission with two line shafts, one for each side of the mill. In the old Simmer and Jack mill, where the batteries were in line, the mill engine was placed in the middle, with fifty stamps on each side and with direct coupling. The Witwatersrand mill has the engine in the middle, but the line shaft is driven by rope-transmission. At the Geldenhuis Deep one line shaft is coupled directly, while the second is driven from the first by rope-transmission. Direct coupling works exceedingly well. Between the line shaft and the cam shaft various forms of belt tighteners are used. In many of the later mills patent clutch pulleys are employed, doing away with the tightening gear.

Very excellent power installations are the rule. In many instances the engine drives not only the mill itself, but also the tailings wheel, the electric light plant, the electric precipitation plant, the shops, and sometimes the crushers. Both vertical and horizontal engines are used, but the latter are in the majority. The usual type is the horizontal compound condensing engine with Corliss valves. To avoid delays an auxiliary engine is sometimes installed. This, of course, is a much cheaper engine than the main engine, and, while not compound condensing, is so made that it can be compounded if desired. The mills are well supplied with mercury traps made of wood, or, preferably, of iron, and have large and well-constructed launders with ample grades. One or more overhead crawls are used along each line of stamps for the rapid handling of the heavy parts of the batteries. The use of electricity for lighting is almost universal, and the old-fashioned, badly-lighted mill has become a thing of the past.

The clean-up room is well supplied with benches and the usual appliances for cleaning up. A pan, barrel, or batea run by machinery is used for the clean-up from the mortars. During operation the outside plates are rubbed every four hours, and the amalgam removed once a day. The general clean-up is made once a month. The percentage of extraction by amalgamation varies, but the average is from 55 to 65. Retorting and melting are not done in the mills, melting being done mainly in the assay office.

The amount of labor used is considerable, and, where one white man is employed in other parts of the world, at least one white and one native are employed on these fields. The labor employed at 100-stamp mill is as follows: 4 amalgamators per shift of 8 hours, 12; 1 engine driver per shift of 8 hours, 3; 1 blacksmith 9 hours shift, 1 carpenter 9 hours shift, 1 fitter 9 hours shift, 1 hoisting engineer 9 hours shift, 1 greaser; total whites, 20; 10 natives, assisting amalgamators, shift of 12 hours, 20; 10 natives assisting mechanics, 10 natives hoisting and dumping; total natives, 40.

Ore-Sorting Floor, Ferreiry Gold Mining Co

Where lifts of more than 40 feet are necessary, plunger pumps are commonly used. The latter have given good service where the proper arrangements have been employed to apply clear water to the plungers to prevent scouring. However, for lifts of less than 40 feet the tailings wheel is most satisfactory, requiring but little power and little or no attention. These wheels are patterned after those used at the concentration works of the Lake Superior copper mines. The temperature being so mild, there are no troubles due to freezing. Tailings wheels, launders, spitzkasten, etc., need no shelter.

The mill of the Simmer and Jack Proprietary Mines being the largest gold mill in existence, and a type of modern mill construction, a description of it is given here: Built on level ground, as are most of the mills on the Rand, the approach to the ore-bins is a raised earthen embankment having a 2½ per cent. grade, over which are drawn, by locomotives, trains made up of trucks of 20 tons' capacity each, which supply the mill with ore from the different shafts of the property, where sorting and crushing have already taken place. The mill building is 269 feet long by 100 feet wide, exclusive of the engine room and boiler

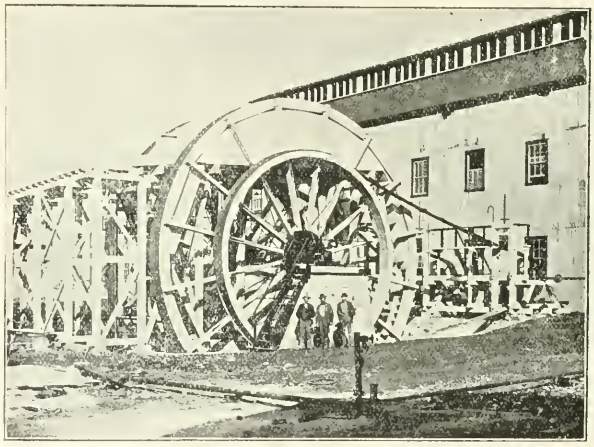
house, the frame being of wood covered with corrugated iron. The ore-bins are rectangular in cross section, the bottoms being flat, and have a capacity of 6,000 tons, or about four days' supply, with the full mill in operation.

The mortar blocks consist of eight karri wood piles bolted together, and the mortars are 4 feet 10 inches in length by 4 feet 8 inches in height, and are lined with steel. The sides are 1 inch in thickness, and the bottoms 9 inches. The feed opening is 3 feet 2 inches above the base, and has a width of 3½ inches for the full length of the box. The height of the discharge is 6¼ to 7¼ inches, and the screens, of 600-mesh steel wire, are 5¾ inches long by 10 inches wide, and have a life of three days, costing 54d. per ton of ore crushed. Amalgamation is done entirely on the outside plates or apron. This is a new departure at this property, as at the old mill inside amalgamation was also practised. The stamps are arranged in groups of twenty, ten being driven by each cam shaft, and weigh 1,200 pounds each. The drop is from 8 inches to 9 inches, and the order 1-5-3-2-4, the minimum of drops per minute being 95.

The cams are of cast steel, and have a sweep the outside diameter of which is 33½ inches. The cam shaft is of fagoted iron with a diameter of 6½ inches, and a length, over all, of 14 feet 3 inches. The cam pulley is of wood, having a diameter of 6 feet and a face of 17 inches. An overhead trolley is arranged under the cam platform for transporting shoes, dies, etc., to the mortar boxes. The mill has been running too short a time to enable an accurate estimate to be made of the consumption of iron and cost per ton of ore crushed. The battery tables have an effective surface 16 feet long by 4 feet 7½ inches wide, a fall of 1¾ inches per foot, and are covered with ⅛-inch sheet copper; they are constructed with one riffle 10 feet down from the mortar box end. A mercury trap is fixed at the end of each table. The pulp from the mortar boxes discharges on lip and splash plates before beginning the descent of the tables. There are two complete steel line shafts, one for each side of the mill, ranging from 10 inches in diameter at the engine end to 6 inches at the tail end. The pulleys for driving the cam shafts are 6 inches in diameter and 17 inches in face. The mill is driven by a compound tandem Corliss surface condensing engine, by Messrs. Yates and Thom, with cylinders 24 x 44 x 54, running at 75 revolutions, giving 900 i.h.p. The driving pulley is 21 feet in diameter, having grooves for 20 1¼ inch manilla ropes, leading off to a pulley 15 feet 6 inches in diameter on the near line shaft, the two line shafts then being connected with rope pulleys 15 feet 6 inches in diameter for 10 1½-inch manilla ropes. Rope tightening gears are used on both drives. There are five 300 h.p. Heine boilers with two 200 tube economizers and one steel chimney 100 feet high and 6½ feet square. The launders in the mill have a 4 per cent. grade, and deliver the tailings to three 50-feet tailings wheels, to be elevated for delivery to the cyanide works. Such a gold mill varies but slightly from the general type in California and the west of America. Distinctly different from this in one feature at least, and peculiar to the mill construction of the Rand Mines Company, Ltd., is that of the single line shaft coupled directly to the crank shaft of the driving engine—a style of mill first introduced in the Black Hills of Dakota. Those of this type on the Rand are of 200 stamps, or constructed for 200 stamps as an ultimate; for instance, the Crown Deep, Rose Deep, Nourse Deep, Jumpers Deep, etc. The ore is delivered to the mill from a central sorting and crushing station, by rope-haulage up an incline, to bins of about 2,700 tons' capacity, and fed by challenge feeders to the stamps.

The mortar boxes are Fraser and Chalmers' No. 102, the height from the base being 4 feet 10½ inches, and length over all 4 feet 10½ inches. The average thickness of sides is 1½ inches; of bottom under the dies, 9 inches. The box is lined with steel. The height of the feed-opening is 4 feet 4½ inches above the base, and the width is 4½ inches. The height of the discharge is 8 inches, and the size of the screen 700-mesh with a life of 36 hours. Inside amalgamation is practised.

The cost of mill construction on the Witwatersrand may be placed at from £400 to £500 per stamp, depending on the size and design of the mill.



New Style Tailings Wheel Simmer & Jack Mill.

THE TALL BUILDING UNDER TEST OF FIRE.*

BY H. DE B. PARSONS.

The modern "sky-scraper" presents many problems, but none more generally interesting than the question of its security against fire. Many imagine that, because iron and steel are incombustible (in the common acceptation of the word), buildings constructed of such material, together with bricks, cement and glass, may be classified as fire-proof. The construction of a building out of materials in themselves non-combustible does not produce a fire-proof structure. The ruin of the Quinsigamond mill, Worcester, Mass., caused by fire April 5, 1896, shows this. The building was erected on the independent plan, a steel frame supporting the floors and roof. The columns were of built-up steel, carrying floor beams of the same material. The window-boxes were of steel, and the walls were of brick built in between the frames so as to enclose the whole. Wood was used for the flooring on the "slow burning" plan. The building was gutted, and the columns and beams twisted into a tangled mass. Witnesses of this fire state that the columns began to yield from fifteen to twenty five minutes after the fire started, although the floors were not heavily loaded. Had this building been erected on the "slow burning" principle, it would have resisted the fire much longer. In this type of construction heavy wooden columns and girders are used, which retain for a considerable time, when subjected to fire, sufficient strength to carry their

*A paper prepared for the Engineering Magazine, and published in the reports of the British Fire Prevention Committee.

super-imposed loads, permitting the escape of the occupants, the saving of valuables, and the arrival of assistance. Such examples show that plans for all buildings in crowded districts should be entrusted only to the best of designers. The design would be much simplified if there were no fear of fire. What constitutes a "fire-proof" structure? The term "fire-proof" has become generic, and is in many instances a misnomer. In its usual sense it is used to designate a certain style of modern structure that has become very popular. Structures of this type rely for their stability, support, and fire-resisting properties, on the steel and iron skeleton frame and on the other non-combustible materials used.

It has been repeatedly proven that metal construction cannot withstand fire, unless well guarded. No matter how "fire-proof" a building may be, it will be ruined, if sufficient combustible material is stored within to create a hot fire lasting for a considerable time. Manufacturers have produced many forms of fire-proofing protection, and have striven to obtain something that will not burn. Architects and engineers have given too much attention to the substance of which the fire-proofing has been made, and not enough to its proper application. It is, however, fortunate that the present tendency is in the direction of protecting the metal skeleton as a primary object, since upon it the self-sustaining properties of the whole structure depend. It should be a secondary object to so sub-divide the floors as to confine the fire.

Without injuring the usefulness or the efficiency of the building, the amount of combustible material now used could, by careful planning, be reduced. In the ordinary American office building wood-work is commonly used to a much larger extent than generally supposed. Taking as an instance a ten-story building of recent fire-proof construction, the wood-work in the floors, panels, bases, chair-rails, doors, window frames, and general trim amounted to about two pounds for each cubic foot of contents. This estimate did not include the furniture or movable office-fittings. The total weight of wood was about 1,200,000 pounds, or as much as the weight of the iron frame. In some of the largest and newest buildings the weight of wood-work has been reduced, but there are many in the sky-scraping class in which the wood considerably exceeds the weight of metal. A number of these tall structures are more vulnerable from fire without than from fire within. The design is often such as to render it difficult for a fire to obtain headway within the building before its discovery, while the same building would be most susceptible to damage if a fire should occur in the immediate vicinity. Designers fail, as a rule, to give due weight to the value of these external hazards. A good example of this is seen in the damage done to the Manhattan Savings Institution building, New York, through a fire on the opposite side of the street. The girders in this building were unprotected, and, failing, permitted the floors to fall.

Some three years ago a joint committee, representing the insurance, architectural and engineering interests, made some elaborate tests of the effect of fire on full-sized metal columns, finding that such columns failed when heated to a faint red color, representing a temperature of about 1,200 degrees F. The steel columns buckled at the centre, while the cast-iron ones bent, snapping, if not relieved of their load, when the amount of deflection began to exceed the diameter. The time required to cause destruction varied from 20 minutes to 2 hours, according to the character of the test—a result which agrees very closely with the failure in the Worcester mill. The cast-iron columns were heated to more than 1,100 degrees F., and were then suddenly cooled by means of a fire stream. No injurious effect was produced, beyond the cracking of the furnace brick-work. The result of our knowledge, based on actual experience and on experiment, is that iron and steel cannot support a load when heated to a faint red. The metal must be protected. It will not suffice to have simply a non-combustible protecting material; the material must be of such a character that it cannot be disintegrated or dislodged either by water or by expansion. The covering must be so fastened as to remain in place, and such fastening is best accomplished by self-bonding, and not by wiring or similar artificial means. The desire of the owner and real estate agent to obtain light for halls at the expense of safety, and to economize space by placing the stairs and elevators in the same well, should be strongly restrained.

It has become possible to consider from a practical standpoint this important subject of a fire-proof building versus fire, by taking as an illustration a recent conflagration in New York city. The building in this instance was no doubt much favored in the assistance rendered by one of the most efficient fire departments in the country. On the night of December 4, 1898, a fire occurred in a five-story ordinary brick and wood building, situated on the southwest corner of Broadway and Warren street, occupied by Rogers, Peet & Co., as a retail clothing store. Adjacent to this, on Warren street, was another, but smaller building of similar design, used as an annex. On the south was the comparatively new Home Life Insurance Building, and, next to it, that of the Postal Telegraph Company. The Home Life Building has sixteen stories, and the floor plan is arranged with a light shaft in the middle of the north side. Along this light shaft are the elevators, and next to them is the staircase. The side and rear walls are of brick, while the front is of marble, built solid from the foundations. The building, with the exception of the front wall, is constructed on a skeleton frame-work of steel. The walls are lined with 2-inch porous terra cotta furring. The floor arches consist of 12-inch and 9-inch hollow, hard-burned, terra cotta blocks, the skew-backs covering with their soffit extensions the lower flanges of the steel floor beams. The columns are of steel, built up, H sections, and covered with 2-inch porous terra cotta furring blocks. The girders are protected on their sides with the same terra cotta blocks, while their soffits are covered with wire lath and plaster. The upper chords of all the girders, except one on the sixteenth floor, are buried in the floors. The principal partitions are made of 4-inch porous terra cotta blocks without metal supports. Many of these partitions are not continuous to the ceiling, being finished off with large plain glass transoms set in wood framing. All the windows were of glass set in wood sashes and window boxes. There are no shutters. The finish of the office floors consists of a wooden floor laid on sleepers placed across the floor beams, and not buried in ashes or cement. The walls and ceilings are plastered. There is a varnished base, chair-rail, window, door, and transom trim. Within an hour after the fire started, a strong northerly to northeasterly gale was driving the flames from the Rogers-Peet building against the walls of the Home Life building and into the light well, which acted as a chimney. The fire entered the unprotected windows of the eight upper floors, and found inside a natural draft through the elevator openings. The result was the total destruction of the contents of the upper eight floors, and the saving of the Postal building by its equally tall neighbor. As a fire stop, the Home Life building certainly succeeded admirably, for, had it not been there, it is fearful to contemplate what might have resulted during a gale of almost hurricane force. Such buildings are not, however, erected or designed as fire stops, and can be so treated only incidentally.

The vagaries of the flames were as peculiar as ever. In one room where the contents were destroyed a waste-paper basket remained, and in another a towel still hung on a rack unscorched, although the room was totally wrecked. The lower eight stories escaped the fire, but suffered from water. There was a total destruction of the finish of the various floors, nothing being left except the absolute fire-proof material. The plaster work, although not combustible, was absolutely destroyed, and in all of the rooms, from the ninth floor up, there is hardly any plaster left on the walls. The wire lathing used over the pipe chases in the walls and over the various irregularities in the building appears not to have stood the attack of the flames. This may have been due partly to the manner in which it was fastened, but more probably to the fact that the metal expanded sufficiently to throw off the plastering, which has no flexibility. The wood-work used in the finish of the building was not preserved in any of the rooms reached by the fire, except in a few in the rear of the building. In some of these a part of the office furniture still remained, although badly wrecked. In one room on the fifteenth floor a tall wall bookcase still stood. The book-shelves were protected by the closely-fitting books placed upon them, while the books were damaged beyond use. Had these shelves, however, been in the front of the building, they, no doubt, would have been destroyed, as there the fire appears to have been fiercest, probably because there were window openings on the north wall of the east wing. Those

partitions which were cut for the purpose of inserting large transom windows near the ceiling suffered most. The glass in these windows no doubt broke, and permitted the flames to spread from room to room, thus removing the value of these partitions as fire stops. The main metallic frame-work was but slightly damaged. A large proportion of the injury was done by the firemen and the building inspectors, and cannot be attributed to the flames.

The destruction of the wooden flooring throughout the upper stories was largely due to the considerable air-space between the wood and the flat floor arches. This space should not have existed; had it been filled, the floors would have stood much longer. The effect of using other material than wood for flooring is plainly illustrated in the various halls, which were subjected to an enormous heat. The flooring of the halls was made of mosaic blocks. These blocks retained their position, and the floors were practically uninjured, although there is nothing left of the wood flooring in the rooms adjacent. The amount of wood used was no doubt excessive, viewed from the standpoint of best practice. Wood-work will not stand a hot fire, even when embedded in the walls. Other material can be adopted for chair-rails, bases, and panellings without injuring the appearance or the utility of a building.

The fire had no difficulty in entering the building, as all the windows on the north side were unprotected. The building might have been saved, had these windows been equipped with iron shutters, and had wired glass been used in a metallic frame. This wired glass will resist an immense amount of heat, and, although it breaks in time, the pieces remain in place. Metal frames fitted with wired glass could have been used to advantage in all the partition transoms. Such an arrangement would have given nearly as much light throughout the building, and would have been a better fire stop. The flames, on entering the elevator shaft, appear to have gone at once to the sixteenth floor as the destruction of the trellis work and iron framing around the elevator doors is greatest at that point. Owing to its position, the staircase was rendered useless as soon as the fire obtained considerable headway, although, as constructed, it was partially protected by the division wall between it and the elevator shaft. The stairs remained intact, so that they could be used as soon as the fire was extinguished. The front of the building was built of solid marble, the poorer pieces obtained from the quarry being used as backing. The facade was relieved with balconies and other ornamentations, and a row of columns supporting arches made a finish to the fifteenth and sixteenth floors. The fire totally wrecked the marble, wherever it was exposed. Marble and granite have but little fire resisting power, and it seems useless to adopt them in a building intended to be fire proof. They are so susceptible to heat as to be liable to injury by fires occurring at a considerable distance. A greater heat than that to which the marble was exposed was endured by the brick work on the north face, and by the brick work up the light well. The chief visible damage to this was the cracks caused by the expansion and contraction of the braces reaching across the light well and stiffening the two wings. Taken as a whole, the building resisted the action of fire remarkably well. Within a week many of the offices on the lower floors were again in use. The steel structure, with the exception of a few portions, such as the girder mentioned above, can remain without repairs. The damage to the floors was slight; and, although the total wreck was great, it was practically limited to the trim and contents of the various rooms on the upper nine floors. The front wall, however, was ruined from the eighth story up. No doubt the destruction would have been less, had as much care and energy been bestowed upon the details of construction and finish as were given to the main frame-work and general plan. The building contained its own fire apparatus, but it is reported that this failed early in the evening. Owing to the height of the building, it was impossible for the fire department to reach the seat of the conflagration. The fire, therefore, had great liberty, although it was effectually prevented from spreading to the lower floors.

Here was a building which was, in the ordinary sense, a fireproof structure, and yet it was damaged. Again arises the question: "What constitutes a fire-proof building?" It is evident that, if fire is brought into contact with articles that are combustible, those articles will be burned; and that, if the fire must be confined to one specific space, that space must be enclosed effectually by absolutely fire-resisting material, which must be so constructed as to form practically a furnace. Such construction is not applicable to a building used for ordinary purposes. The next step, then, is to so arrange the structure that, when fire takes place, no damage shall be done to the main members, whether those members be of masonry, iron or steel. In all our cage constructions the members needing the greatest protection are the columns, girders and beams. It is not difficult to protect these members effectually, provided the owner and the designer are willing not only to spend the proper amount of money and care, but to give up the requisite floor-space. This part of the problem was fully illustrated in the Home Life building, as the only members seriously injured were the unprotected parts of the metal structure. It is axiomatic to state that floors should be separated from each other, so as to confine the flames. This is a condition difficult to attain, as perforations must be made for both stairs and elevators. These openings are generally placed so as to take a minimum of floor-space, and thus render a maximum area available for income-earning purposes. Nearly every intending builder examines the various buildings, estimates the amount of space devoted to public use, and concludes that the best building is the one that has given up the least percentage of space. While this effort is commendable from the purely income earning standpoint, it not only has the effect of rendering the design dangerous to life and property, but makes it almost an impossibility to so design a building that it shall be fire proof. In any building there must be, and always will be, an amount of combustible matter that cannot well be reduced. It is, therefore, essential that the least amount of combustible material shall be used in construction. In those

New Windsor St. Station of C.P.R. at Montreal.

The wing on the left has been hitherto the Main Building. The frontage of the extended structure, on Osborne Street, is 325 feet. The floor space is increased from 50,404 square feet to 102,131 square feet.

rooms in the Home Life building which suffered the least damage, it was clearly shown that the combustible materials placed near the ceiling were destroyed more rapidly and more completely than those nearer the floor. The heat and flames naturally follow the ceiling, and the ordinary fire-proof partitions in which there are large transom windows are thus rendered useless as fire stops. The use of transoms in these partitions is no doubt a necessity, but they should not be fitted with material so friable as ordinary glass. Even in a fire-proof building dependence must be had upon human aid. When the building is tall, it towers beyond the reach of the fire department, and reliance must be placed upon other means. A fire in the lower stories is easily accessible; the conditions to be most dreaded are those of a fire in the upper stories.

Many modern tall buildings are designed with their own pumping plant to supply a roof tank for fire and other purposes, and are equipped with a large stand pipe from six to eight inches in diameter, which is siamesed on every floor for hose connections. This stand-pipe is also arranged with a check valve and with siamesed branches at the foot, so that fire engines can be attached, in case of the disability of the self-contained plant. It is well so to arrange the stand-pipe that the engines can also operate in conjunction with pumps in the building.

In many cities which maintain a system of fire boats there are laid underground pipe lines of large diameter. As these fire boats are equipped with pumping apparatus far exceeding the power of the largest land engines, they are able to force water under heavy pressures to long distances, provided the mains are made of sufficient area to minimize the friction losses. This system, operated in connection with the building stand-pipe, would materially assist the firemen.

The question naturally arises whether it pays the owner to make a building thoroughly fire-proof. Unfortunately there are many who build for the specific object of obtaining the greatest income from a minimum outlay, and the effort to save on the first cost is so great as to render their judgment valueless as to what should or should not be done. Tall buildings of cheap construction are a menace not only to the owner and tenants, but to the community. Too much stress cannot be laid upon the great aid that could be rendered, but unfortunately is not, by the insurance companies. If they would be more strict in the classification of their risks, improvement would immediately follow. Are these tall buildings really good investments? The increase in height appreciates the value of the land, but how much of this appreciation is offset by the depreciation of the building, by the extra cost of maintenance, insurance, repairs, taxes, interest, etc.? In other words, would not a smaller building pay a greater percentage upon the money invested, if a careful and accurate balance sheet should be drawn up? Following the same line of thought, there has arisen the question whether the height of buildings should not be limited by law? If every building could be constructed upon utopian principles, probably there would be no reason to limit the height other than one of a purely aesthetic character. As such a state of affairs does not, and probably never will, exist, and as so-called fire-proof buildings are liable to be constructed, it seems that some form of proper restriction would be advantageous to the community.

THE SMOKE NUISANCE.

Montreal is taking active steps towards the abatement of the smoke nuisance. Complaints from people living within a considerable radius of a factory or public building where soft coal is used, are frequent. The smoke is a great inconvenience, as doors or windows cannot be opened for purposes of ventilation; clothes hung out on wash days are ruined; the houses themselves rapidly become dingy in appearance, and the smoke finds a lodging on the roofs of the buildings, lies there until rain comes and washes the combination of soot and water down the walls, leaving them streaky, and indelibly defacing the architectural beauties of many fine buildings. Manufacturers are consequently put to much expense and great annoyance in trying to do business, and at the same time keep the peace with their residential neighbors. Many devices are on the market which effectually burn the smoke and save the coal when properly handled, but what is needed is a smoke consumer, which can do the work, and yet be within the reach of all. The makers of the Redpath-Reid patent smoke consumer claim that with their machine the best results are achieved.

NEWFOUNDLAND'S MINERAL WEALTH.

Belle Isle is reached by a twelve-mile drive from St. John's to Portugal Cove, on the first road ever built in the colony, some 70 years ago, writes J. Ewan in special correspondence to the Toronto Globe. The Cove lies opposite the southern shore of the island, but between them there runs about as tricky a piece of water as there is around the coast of Newfoundland. The island presents a perfect precipice to the sea at all save two or three points. It is eight miles long by two in width, and contains farming lands that are superior to anything on the adjoining mainland.

The Nova Scotia Steel Company was the first to begin the extraction of ore at Belle Island. The idea appears to have been to get enough ore for its own use, and the company went to work in a tentative way. It was fortunate enough to secure the management of R. E. Chambers, a Nova Scotia man of wide experience and resourcefulness. As the original plans did not contemplate the getting out of a great deal of ore, it is remarkable that they were so laid as to be adaptable to a much larger output when the demand for the ore ran away beyond the original modest estimates. Work had not got well started before it was found that besides supplying its own iron and steel works in Nova Scotia, the company had the opportunity of selling the ore to German furnaces. It took all the orders of this kind that came, and latterly orders came from the United States, so that during the last year closed, instead of the few thousand tons that would have been sufficient for the company's own purpose, it will have shipped out 300,000 tons.

The side of the island on which the ore lies fronts a sea in which vessels would have no protection in a storm. On the other side facing the mainland, there was a slight recess in the bold shores where a vessel could lie at a wharf in comparative safety. The choice of this side for shipping necessitated the building of a cable tramway across the width of the island. It is a double track, two feet gauge, an inch steel cable passing around wheels at each end and down the centre of tracks. On to this moving cable the steel cars, containing each a ton and a third of ore, are attached as soon as filled at the mine, and they start their journey across the island to the pier. The cars are strung along the cable not more than ten or fifteen yards apart, and one of the sights of the island is this procession of little vans, those on the west track full and those on the east track empty, proceeding at a stately pace across the country. On arrival at the pier each is in turn automatically dumped into enormous pockets and starts in the procession of "empties" back to the mine to be filled again. The steamers are loaded from the pockets, and the facility with which this is done may be gathered from the fact that a steamer has been loaded at the pier with 6,400 tons of iron ore in four hours and a half.

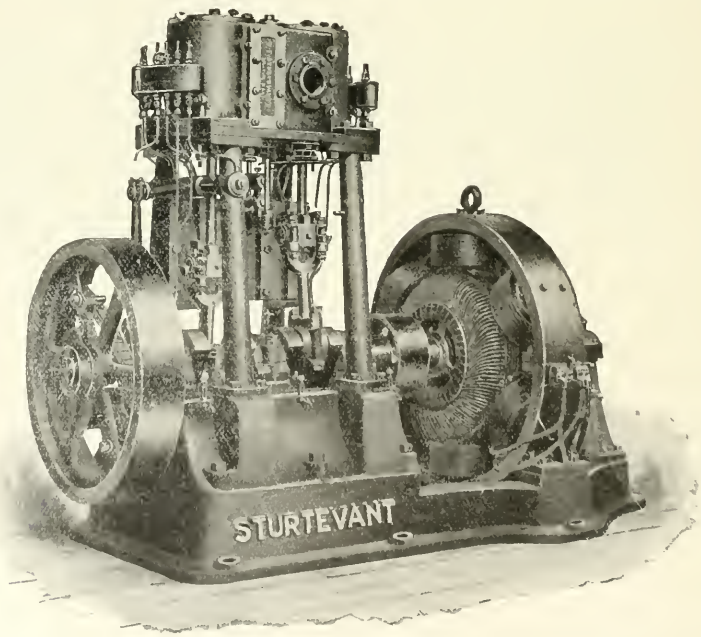
The pay roll of the Nova Scotia Steel Company on Belle Isle in October was $24,000, and when the other company gets to work next year that sum will be at least doubled. The Nova Scotia Company is by no means through with the island. It still retains the upper bed, and is at the present moment building a duplicate of the first pier at a sheltered spot on the coast to the west. The road-bed for a tramway is already laid across the island, and it is quite likely that its operations next year will be quite as great as this year. The statement is made that the Whitney Company will get out 500,000 tons of ore a year, and the construction of a second tramway, making the third across the island, seems to indicate that they contemplate a greater output than their predecessors. "What I like about Belle Isle," says Mr. Ewan, "and the other effects that flow from it, is their actuality. Here one is not stuffed with talk, but feasts his eyes on facts—on thousands of men at work, at vast vessels obeying their mistress, commerce, and ingenious machinery working the will of man. The whole arithmetic of the situation is that this ore can be laid down at Sydney at a cost of probably less than 50 cents a ton."

Not far from Belle Island is Bai de Verde, where an English company, the Newfoundland Iron Ore Co., has been at work for

a considerable time at the preliminaries to mining an iron deposit there. The main shaft is at Worthington, near Lower Island Cove. The ore is a red hematite and is said to be of a higher grade than that in Belle Isand. It is said that 500,000 tons are in sight. The company has spent a large amount of money, but as yet has extracted no ore. The Tilt Cove Copper Mine has been operated since 1868, and last year was perhaps its most profitable year. Every once in a while reports have been circulated that it was at the end of its tether, but it has always come up smiling, and let us hope that it will always do so. About 200 men are employed at the mine. Petroleum has been found at Parson's Pond, at St. Paul's and at Port au Port, but the value of the find has not been demonstrated. There are fine slate deposits at Britannia Cove, Trinity Bay, the product being it is claimed better than any in the United States. The quarry has been sold very recently to Harvey & Co., an enterprising firm in St. John's, for the sum of $25,000. The facilities for shipment are excellent, and England is the market which the owners have in view. A gypsum deposit on St. George's Bay has been leased by a company at a rental of $1,200, with a right to purchase for $30,000, and preparations are being made for an active output. And to all such enterprises every friend of the colony will bid God-speed.

A SUBSTANTIAL TYPE OF MARINE GENERATING SET.

In the design of the generating set illustrated herewith, the features of compactness, accessibility, economy and stability, with consequent lightness of parts, and ability to maintain an excessively high rate of speed during a long period, have, it is claimed, been most carefully developed.



The engine is two cylindered, the cylinders having their axes parallel, and being contained within the same casting. The diameter is very large relatively to the stroke, the size represented here being 9 inch cylinders with 5½-inch stroke. The valves, which are of the piston type, are two in number, placed in spandrels between the cylinders, and actuated from a yoke below, which in turn receives its motion through a rocker arm from the eccentric. The valves, which operate in unison, are so designed that steam is coincidently admitted to the top of one cylinder and the bottom of the other. The motion of the pistons is transmitted through large piston rods to slipper cross heads, and thence through marine type connecting rods to the double crank below. The crank pins are set at an angle of 180 deg., so that the vertical motion is balanced, one crank moving upward as the other moves downward. This feature is instrumental in the securing of a high rotative speed.

The cylinders are supported upon four heavy columns as shown, the rear columns supporting the guides for the cross-heads, and all being securely bolted at the bottom to the very substantial bed casting. This bed carries three main journal bearings, brass bushed in their lower halves, and provided with continuous oiling devices in connection with oil receivers beneath. The interior of the bed forms a basin, which collects all drip from water or oil.

The regulator is of special construction, and arranged to operate the valve in such a manner as to regulate the point of cut-off for all loads. It is exceedingly powerful, although sensitive to very slight changes in speed. The connecting rod and cross-heads are of forged steel, the cylinders are thoroughly lagged, and an oil tank is mounted upon each end of the cylinder casting, and provided with individual sight feed oilers, and connections to the various bearings.

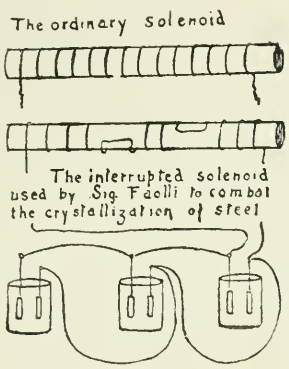
The generator, the armature of which is coupled to the engine shaft, is carried upon a continuation of the engine base, and is of the six pole type with outboard ring boiler bearing. Its capacity is 425 revolutions per minute (the speed of the engine is 40 k.w.). The field ring is of cast-steel. The cores are of wrought iron with cast iron shoes. The armature is built upon a spider, and is arranged for thorough ventilation through internal ducts, extending out through the armature windings. The armature in operation acts as a blower, and causes the passage of air through these ducts. The series winding of the field coils is of flat copper ribbon, and the shunt winding is of wire. Both windings are placed on the pole entirely independent of each other, and either may readily be removed. Their design is such as to permit of free circulation of air upon all sides. The generator is designed for sparkless operation under all changes of load from no load to 25 per cent. overload, with a limit of temperature rise to 90 deg. F., after a full load run of 10 hours. This set was designed by the B. F. Sturtevant Co., Boston, Mass.

Wilson & Smith, Worcester, Mass., are now occupying their new factory recently built for them, and though much more than the usual number of orders are in hand, they are filling them promptly. The firm is now carrying a larger stock of nuts and washers of all sizes than ever before. The chief output of this firm takes the form of specialties punched from cold iron, steel and brass and the making of dies for this class of work

OVERSTRAIN IN STEEL.

Owing to the large use of structural steel at the present time a great deal of interest is being taken in the question of the probable life of structures, such as high buildings, bridges, etc., which depend wholly for their strength upon this material. An Italian electrical engineer, Emilio Fealli, has just made a discovery, which he claims is a means of effectively preventing crystallization. A bridge at Setro Ponente, about ten miles to the north of Genoa, Italy, collapsed on three different occasions within a dozen years. Another bridge near Pavia had only just been constructed and was being tested when it snapped in the middle. Making a study of these accidents lead Signor Faelli to experiment with overstrained steel, and finally, when experimenting with what is known as a "tired" razor and an electric cement, he discovered that the application of electricity would restore strained steel. He tried an electrical current traversing a solenoid placed around the razor, the current being controlled by the intercalation of a tuning fork. On trying the razor he found it in a relatively good condition for its ordinary work. This was a proof that the crystallization had been partially nullified. His solenoid was one of perfect tubal curve, and he got better results with an interrupted spiral curve.

A solenoid, the coil of which is in one direction, carries current running in an unchanging course, and symmetrically magnetizing any soft iron that may be placed in its centre. A



solenoid, on the contrary, whose curve is interrupted, carries a current which changes with the frequency of the interruptions, and has peculiar effects on metal placed within it. It induces in the metal, independently of the extreme poles, as many interior poles as there are alterations in the coil.

The following is an abstract of a paper on the Recovery of Iron from overstrain, by Jas. Muir, B.Sc., Trinity College, Cambridge, which was communicated to the Royal Society by Prof. Ewing, F.R.S.:

It has long been known that iron which has been overstrained in tension—that is to say, strained beyond the yielding point, so that it suffers a permanent stretch—possesses very different elastic properties from the same iron in its primitive condition. The material is said to be "hardened" by stretching,[1] since the ultimate effect of such treatment is to raise the elastic limit, and reduce the ductility of the material.

More recently attention has been called to the fact that, primarily, the result of tensile overstrain is to make iron assume a semi-plastic state; so that the elastic limit instead of being raised by stretching is first of all lowered, it may be, to zero.[2] This plasticity may be shown by applying a comparatively small load to a bar of iron or steel which has just been overstrained by the application and removal of a large stretching load. When the small load is put on, the bar will be found to elongate further than it would had the material been in its primitive state; and a slight continued elongation—a "creeping" may occur after the small load has been applied. If this load be withdrawn a quite appreciable permanent, or semi-permanent, set will be found to have been produced; a set which diminishes slightly, and, in all, may vanish provided time be allowed for backward creeping to take effect. It may also be shown that if the reapplied load be increased the elongation produced will increase in a greater proportion. Thus if a stress-strain curve be obtained from a recently overstrained bar of iron or steel, it will show even for small loads a marked falling away from the straight line which would indicate obedience to Hooke's law.

It is recovery from this semi-plastic state induced by overstrain to a condition of perfect or nearly perfect elasticity, with raised elastic limit, that is referred to in the title of the paper of which this is an abstract. Such recovery is known to be effected by mere lapse of time,[3] and the object of the experiments described in the paper and summarized here, is to show the effect of moderate temperature, of mechanical vibration, and of magnetic agitation on this slow return to the elastic state; and, further to illustrate this recovery by means of compression tests. One section of the paper deals with the phenomenon of hysteresis in the relation of extension to stress which is exhibited in a marked degree by iron in the overstrained state. Incidentally attention is called to subsidiary points of interest.

The experiments were carried out in the engineering laboratory of Cambridge University, and were the outcome of suggestions by Professor Ewing. It was on his suggestion that the effect of moderate temperature on recovery from overstrain was tried, and the result of that trial led to much of the work incorporated in the paper. The straining and testing were done by means of the laboratory 50-ton testing machine, the specimens employed for the most part being taken from steel rods one inch in diameter, of a quality which may be described as semi-mild. The small strains of extension were measured by Professor Ewing's extensometer.[4]

After referring to the apparatus and the material employed, and describing the method of experimenting, there are first given in the paper examples of the slow recovery of elasticity with lapse of time. These examples are illustrated by stress-strain curves obtained, at succeeding intervals of time, from extensometer readings similar to those tabulated by Professor Ewing in his paper, referred to above, "On Measurements of Small Strains in the Testing of Materials and Structures." Recovery is shown to be at first comparatively rapid; but latterly very slow progress is made, and weeks or months may be required before an approximately perfect restoration of elasticity is effected. When this is brought about, the specimen may be subjected to a stress a few tons per square inch higher than that at which the virgin material yielded, before a yield-point is passed and the material once more brought into a semi-plastic state. If sufficient time be allowed to elapse after passing this second yield-point, an elastic state will again be assumed, and a third yield-point may be obtained about as far above the second yield-point as the second was above the first. In this manner four or five yield-points may be obtained with the same specimen before fracture occurs. A specimen broken in this manner shows greater ultimate strength, but less ultimate elongation than would have been obtained had fracture been brought about in the usual fashion, that is, without allowing intermediate recoveries of elasticity to take place.

The question of recovery of elasticity under stress is next considered in the paper, and it is shown that the process of recovery proceeds at practically the same rate whether the material is kept stressed or is allowed to rest free from load. A slight difference, however, is shown in the two cases, as restoration of elasticity takes place about the position of continued stress. After this, the phenomenon of hysteresis in the relation of extension to stress is considered, and a closed cycle is shown, having features analogous to those exhibited by a magnetic hysteresis cycle.[5]

The effect of moderate temperature on recovery from overstrain is next treated of, and it is shown that a slight increase in temperature hastens the restoration of elasticity to a remarkable extent. Three or four minutes at 100 C. proved to be more

[1] Ewing, "On Certain Effects of Stress," 'Roy. Soc. Proc.,' No. 205, 1880.

[2] Bauschinger, 'Civilingenieur,' 1881, or 'Mittheilungen aus dem Mech. Teeb. Laboratorium in München.' An Account of Bauschinger's work is given in Unwin's book on 'Testing of Materials of Construction.' Ewing, "On Measurements of Small Strains in the Testing of Materials and Structures," 'Roy. Soc. Proc.,' vol. 58, April, 1885.

[3] Bauschinger, 'Dingler's Journal,' vol. 274, p. 5; or 'Mittheilungen aus dem Mech. Tech. Laboratorium in München.' Ewing both papers already cited. Reference might also be made to Lord Kelvin's discovery of the effect of a Sunday's rest on wires which had been subjected to torsional vibrations throughout the preceding week.

[4] For description see paper already cited, "On Measurements of Small Strains, etc.," Roy. Soc. Proc., vol. 58, April 1895.

[5] Ewing, "Experimental Researches in Magnetism," 'Phil. Trans.,' 1885, or book on 'Magnetic Induction in Iron and other Metals.'

efficient than a fortnight's rest at the normal atmospheric temperature. The effect of various temperatures below 100° C. is then investigated, and so moderate a temperature as 50° C. is shown to have a large influence in hastening recovery from overstrain. The manner in which recovery proceeds with time when the specimen is kept at a constant temperature is shown in the paper by means of curves. These curves show that at first—that is, before elasticity is fairly well restored—the amount of recovery, measured by the diminution in the elongation produced by a maximum load, is proportional to the square root of the time. For example, the effect produced by, say, four minutes at 80° C. was approximately double of that produced by one minute at the same temperature. By subjecting an overstrained specimen to temperatures above 100° C., no effect (other than the recovery from the temporary effect of overstrain) was found to be produced until a red heat was almost attained. When the specimen had been subjected to an annealing temperature, of course the whole effect of overstrain was removed, and the material assumed its virgin state.*

After the effect of temperature is discussed, that of mechanical vibration is next recorded in the paper; and it is shown that by striking a recently overstrained specimen with a hammer, so as to make it ring, the material of the specimen is made less elastic. That is, the effect of mechanical vibration is opposite to that of increase of temperature; recovery of elasticity is not hastened, but the material becomes more semi-plastic after mechanical vibration than it was before.

The influence of magnetic agitation is next described. A recently overstrained specimen was subjected to magnetic reversals by means of a coil giving a field strength of 1.40 C.G.S. units at its centre, but no change whatever was detected in the elastic condition of the material; the process of recovery seemed to be neither accelerated nor retarded.

For the compression experiments described in the paper, an instrument, specially designed by Professor Ewing, was employed to measure the small compressioned strains. By the aid of this instrument, the semi-plasticity of recently overstrained iron was readily observed, and the effect of moderate temperature in restoring elasticity was demonstrated by means of compression tests. The lowering of the compression yield-point which accompanies the raising of the tension one (due to tensile overstrain) was also clearly shown. This lowering, however, was not found to be such as to keep the total range of elasticity for the material constant; that is, the lowering of the compression yield-point was not found to be equal to the raising of the tension one. In conclusion, the characteristics of overstrained iron are considered as illustrating Maxwell's views on the "Constitution of Bodies," as set forth by him in the "Encyclopaedia Britannica."

*See paper by Unwin "On the Yield-point of Iron and Steel, and the Effect of repeated Straining and Annealing" 'Roy. Soc. Proc.,' vol. 57, 1895.

AN IMPOVERISHED PHILOSOPHER.

There are times in his life when an editor wishes the readers of his work would promptly pay their indebtedness, and there are moments, such as when we opened the following explanation of a returned draft, when we are glad to have something coming to us, even if it is only a joke:

Biggar, Samuel. and, Co

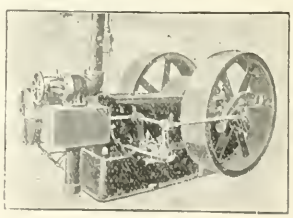
Montral, Canada.

Dears Sirs I received yours of 27 Contents Noted. My silance in the Past has not bin frome Eny Desier on my Part to avoid Payment, or to Shurk My Respsnoobiley. the Matter in Question I had Hoped that Maters might git Better and, I Would be able to Pay you but as matters Was Worse each year I thought best to Stop your Paper forme coming longer in explaination of My Present financial condition. I Secured a Pattint on a Submerged Dredger (a World Beater) this was in 93 I of cors flirted with the goddis of Fortion that Presided over the destines of Patent Right Men, and Smile While they Build Air Castles. But Smash them With as little Remors as a Kansas Tornado Would dew I listind to hir wewing for two years and when I Realised the truth of the Situation My finances, and financial Reputiton Was just in the fix of a Box Haus after the Kansas sicloun, Recognisable by Former Land Markes. I Will mention some of the Most Promihent land markes that exist to marke the Remains of What Wanst Was, namely a judgment for $6000 buy one Partey, a judgement for $800 but a nother Party, and $2,000 subject to judgment if the holder of the note cairs to take it, in all my missfortuns no one That Knos me acuses me of trying to Swindle them in further explanation I will state that I yet owe Borowed Money to some of my friends I cannot Pay other obligations untill I am able to Pay them something I ame to treat all my Credeter as just as, I can. I havent a sent in the Business, for when I waked up, I was not as, Ragged, as, Rip, VanWinkle but was, as Poar, and did not have a god, to comfort me, in conclusion I Will say. I fully Recognise the justness Your Bill You Pubelacation's good and I appreciated them and have most all of them yet. You bill is recorded on the Tablets of my Memorie, and Will Paid When Reached in ther turn if Gabral dont tute hir Horn and say to, me Robbins With you time is, nomore, then the vail that hides the imortal form them that, Reman Will be drawn, then we will be remembored onley, with, those that ar gon to that Born frome Whence no travler Return. We ar taught, in, the leson of Faith Hope and Charity that Faith ends at the grave, hope in Fuition but, Charity Endureth forever. We Hop that with Charity We may be judged. in conclusion I will say. I have for, 4, years, Tryed to keep forme furnish in a citison of a Foren Countrey, a sample of my spelling But you have cornerd me and her it is. Hoping we may soon have things adjusted to your satisfaction I reman as ever

Fort Worth, Texas, July 3rd, 1899. J. M. Robbins.

THE PEERLESS SELF-OILING AUTOMATIC ENGINE.

We here illustrate this new modern self-oiling engine now placed on the market by E. Leonard & Sons, London, Ont. The makers claim every possible improvement in connection with it that is now in existence on the best class of engines offered for sale in the United States or Canada. The points of great advantage claimed are as follows: The engine bed is of a new type, most rigidly designed to withstand high pressure steam; the governor is Ball's latest patent, Class E., much simplified, only having one spring and weight, and made now without the dash pot; it is so perfect in regulation that it will not vary 1 per cent. from no load to full load; the engine valve is perfectly balanced, has a double face and cannot leak. This firm have engines that have been in constant use for fifteen years, and never yet a case of leakage, and have no record of having any of these repaired. The self-oiling system supplies oil at a proper height in the body of the frame, so as to lubricate the crank, cross-head and the engine bearings, without the least appearance of oil shown outside of the engine, doing away with all oil cups in this location. The engine shaft is made of forged steel. The cross-head is of steel, of the new slipper type, and is adjustable. The cross-head has very large wearing surface. A space is left between the cylinder and gland, which prevents the water following



the rod into the frame of the engine. The main bearings can be adjusted when the engine is in operation. All of the parts are made of the best material and workmanship, and the fixtures, as shown, are first-class in every way.

The recent sales made by this firm include: W. H. Fowler (tandem compound), St. John, N.B.; Acadia Electric Co. (tandem compound), Wolfville, N.S.; London Electric Co. (simple direct connected), London, Ont.; United Electric Co., of Toronto, Ont., for Henry Morgan, Sons & Co. (simple direct connected), Montreal, Que.; Electrical Construction Co., of London, Ont., for Victoria Hospital (simple direct connected), London, Ont.; Anderson Furniture Co., Woodstock, Ont.; Bennett Furnishing Co., London, Ont.; Messrs. D. W. Karn & Co., Woodstock, Ont.; Anderson Furniture Co., Woodstock, Ont.;

Wm. McMaster, Ridgetown, Ont.; W. H. Meldrum, Paris, Ont.; Joseph Orr, Stratford, Ont.; Palmerston Pork Packing Co., Palmerston, Ont.; Corporation of Dundalk, Dundalk, Ont.; Smith's Falls Malleable Iron Co., Smith's Falls, Ont.; J. W. & W. A. Hutchinson, Berwick, N.S.; H. Webster, Norwich, Ont. This firm have the following agencies: H. E. Plant, 109 Common street, Montreal, Que.; Geo. H. Evans, 62 Water street, St. John, N.B.; Thomas Nopper, traveling agent for Western Ontario, London, Ont.; Stuart & Harper, Winnipeg, Man.

THE MANUFACTURE OF STEEL FOR BUILDING CONSTRUCTION.*

BY F. H. KINDL.†

The first portion of the paper described in a popular way the processes which are gone through in the reduction of the iron ore, the conversion of the molten metal to steel, and its rolling into structural shapes. The paper then continues as below:

It is evident that for every different size beam, channel, or other shape, the entire set of rolls, from the cogging mill to the finishing rolls, must be changed; that is, the rolls and couplings must be removed and others put in their places. They must be reset and lined up true, so as to produce the proper design and weight of shape in the finishing pass. The weight of material moved—that is, rolls, couplings, etc., to be reset and relined—amounts to very nearly 175 tons in the large beam mill; and right here, gentlemen, it will become apparent to you that owing to the time required in roll changes we have a heavy factor in the time of delivery or, better, non-delivery in fixed time of your client's material. The cost of changing rolls, you can also see, must be considerable, and if we take but $1 per ton for labor of moving and resetting we have at once $175, and a proportional amount for the smaller mills, noting that no account is made therein for the cost of skilled labor required to reset and line up the rolls, taking from three to ten hours, depending upon the mill required to be changed.

A great deal of time is also required to change from one weight to the same shape and depth of another weight, so you can readily appreciate how it can occur that one building is erected so much quicker than another, and, I dare say, cheaper to your client, due simply to the use of standard sizes and shapes throughout in the construction of the steel skeleton, noting that the fewer the sizes used the quicker can the work be delivered. While this tendency toward the use of standard shapes has been very marked in the past few years, it could still be extended further, and it will no doubt interest you to know that in countries using the metric system architects and engineers long since adopted a standard of shapes, in conjunction with the mills, which are strictly adhered to, and none but the minimum weights in a fixed size are ever used. I am sure the sooner we adopt such a system the better it will be for all concerned.

But we must not forget our beam, which, no doubt, by this time, has left the last pass, or finishing pass of the rolls, and is now lying on the long roll table, ready to have a test piece cut from it and stamped with its blow number, representing the constituents of the steel, and to be cut into ordered lengths. The test piece is carefully prepared and sent to the testing laboratory, where its elastic limit, ultimate strength, and elongation and fracture are carefully measured and recorded, with the chemical constituents. The finished beam, cut to length, which has, until now, been lying flat on its side, is automatically turned up so as to rest on its flanges, as in its normal position in a building, and is quickly pulled across a series of rail skids, called cooling beds. Here it is allowed to rest until its turn comes to be straightened. The straightening machine is in direct line with the end of the cooling bed, and the beam is automatically guided through the machine, coming out of same true and ready to be shipped direct to destination, if plain, or transferred to the fitting shop, if work is to be performed thereon. Practically the same manner of manipulation as for beams applies to channels, rails, and other shapes.

For plates, the ingot is first reduced to a slab in the preparatory mill—called slabbing mill—which slab, as a rule, is reheated and then rolled flat to the required width and thickness in a plate mill. Plates having a width of over 48 inches or less than ¼-inch thick are rolled in an ordinary plate mill—that is, one having only horizontal rolls—and plates rolled in such a mill must have their edges sheared in the direction of the length of the plate, subsequent to rolling and straightening. For plates under 48 inches in width and over ¼-inch thick, this shearing is not necessary, as true edges can be obtained in a plate mill having, besides the same horizontal rolls as the ordinary plate mill, a set of vertical rolls. Such a plate mill is called a universal plate mill.

Plates 6 inches and less in width are worked in grooves cut into rolls similar to those for shapes, and can be rolled in the same way as shapes. It being a less expensive process than that used for plates, most bars are rolled in this manner.

All plates, after being rolled to the required width and thickness, are apt to be buckled, owing to internal stresses or unequal heating at different points of the plate, and must be straightened by means of subsequent rolling. A set of these straightening rolls is placed in line with the feed table in the plate mill, and the plates are automatically conveyed through them, being still quite hot. They are then carried on a long roll table to the template department, and there laid off to template, all this being performed while the plate is on the roll table. They are then carried along to the shears, placed at the extreme end of the plate mill department, and cut to the template marked thereon. From here they are directly shipped to their destination.

Having now completed the rolling of our plain material, we will visit the fitting shop for beams, where all our beams and channels are sent to be fitted, i.e., either to be—1st. Punched in web only, one or more size holes. 2nd. Punched in flanges only, one or more size holes. 3rd. Coped on one or both ends, after being punched. 4th. Riveted with connecting angles on one or both ends. 5th. Riveted into beam girders, with one or more cover plates. 6th. Bent or forged in blacksmith department.

As soon as the operation of the beams through one or more of the above processes is complete, i.e., when fitted as required by shop details, they are slid into the shipping yard on skids, ample room being left for this purpose between the different machines. Naturally, the less work to be performed, the sooner can the beam or other material be shipped, and in this respect the architect can materially assist in his plans and specifications. We will draw attention to some of the worthy points to be considered; noting, however, that they are not necessarily applicable in all cases, and good judgment must govern their use.

First. Specification, if possible, should call for only one size of hole to be used, namely, ¾-inch diameter, thus avoiding two operations and handling of material from one punch to another. Second. Avoid coping by setting the floor beams sufficiently below the top flange of the main beam or girder, providing this latter is of sufficient depth. Third. Avoid beam box girders, by the substitution of beams of greater depth. Fourth. Avoid blacksmith work—that is, bending, welding, etc., by proper design of riveted members.

We now take a hurried look at the column shop, and here are found machines to perform the workmanship on the various classes of material, which, after first being laid off and punched, are assembled and subsequently riveted together to the finished column, which is then faced to the exact length; noting that all parts inaccessible after riveting are painted.

The total cost of the structural steel erected in a building, of course, depends upon the weight required and the current quotations for the plain material, as well as upon the workmanship thereon, its hauling to and erection at the building site. The weight of structural steel in a building is very difficult to estimate, unless plans and specifications are first drawn up, as this will depend upon the design, the number of stories, the dead and live load to be carried per square foot of floor, the weight of brick or stone work resting on the outside girders, and the allowable unit stresses on the steel. While the allowable stresses per square inch are pretty well determined by our building laws, which are almost identical with each other, yet the former factors are of so wide range as to make each individual case different. However, for the weight of the steel skeleton of the average office building, whose walls are car-

*Extract from a paper read at the 33rd annual convention of the American Institute of Architects, at Pittsburg, Pa.

†Structural Engineer Carnegie Steel Company, Limited.

ried by the steel work, we have found by careful records of the weight of steel required that the following formula can be used with sufficient accuracy for preliminary estimates:

$W = N \times F\ (15 + 7/10\ N)$, in which "W" is the total weight in pounds of the structural material required: "N" is the number of floors, including the roof as a floor, and "F" is the number of square feet in each floor. The first number inside of the parenthesis when multiplied by the quantity N F, will give the weight of the beams and fittings required in the floors, while the second number multiplied by the same factor represents the weight of the columns. Thus we have for the weight of the skeleton steel for such a building, having a floor area of 10,000 square feet and 15 stories high, 2,400,000 lbs. of beam work and 1,792,000 lbs. of column work, or a total of 4,192,000 lbs. of steel work.

As regards the cost, while this will vary somewhat, due to design, we might safely assume that unless the construction is complicated, owing to an irregular lot line or unusual construction such as is found in theaters, music halls, etc., the average cost for fitting beams will seldom exceed ½ cent per lb. above the price of plain material, including the painting, and for column work, 1¼ cents per lb. above the price of plain material. We have, therefore, for our building noted above, assuming that the price of plain material will average 2 cents per lb., the cost of the beams would be 2½ cents per lb., and that of the columns 3¼ cents per lb., or a total cost of, beams, $60,000, columns, $58,240, and a total amount of $118,240 for the steel work f.o.b. cars Pittsburg, painted. To this must be added the cost of freight, hauling and erection. The hauling can generally be done for 50 cents per ton, while the erection will seldom exceed $6.50 per ton, thus making the hauling and erection $7 per ton. The hauling and erection of the steel for our building would therefore be $14,672, making a total cost of $132,912 for the steel work, erected in Pittsburg, as per your plans and specifications. These figures are kept somewhat on the safe side, and appear high to-day, owing to the use of a base price of 2 cents per lb. for the plain steel, which, as you know, is almost double the market price of one year ago. Since writing this paper the price of steel has again advanced and the cost of our building would now be very nearly $15,000 more.

HEATING.

In the progress of civilization more efficient arrangements for heating have gradually been adopted. Fire-places, stoves and furnaces have, in the order named, been introduced as means of warming. For small rooms, as in dwellings, they answer very well; but the effect of opening or closing windows and doors, and of changes in the atmospheric conditions, is too well appreciated to need recital here. It will certainly be admitted that a building can seldom be found where the heated air is properly and satisfactorily furnished and distributed by a furnace; some of these influences are sure to act, and at times it will be impossible to heat certain rooms without the closing of doors or shutting of registers in other rooms.

More exact are the methods of heating which are dependent upon the use of steam or hot water, confined in radiators or coils. Under systems of direct radiation, these are placed in the rooms to be heated, but seldom with any provision for the introduction of fresh air. By the indirect method of placing the heating surface in ducts connecting with the rooms and permitting outdoor air to pass across such surfaces, a much nearer approach is made to good ventilation. But still it is practically impossible by such mean alone to produce the air-flow, and maintain the temperature necessary for a large and crowded apartment. It is evident that some positive means, like the fan, must be applied to render such systems reliable at all times. Experience has demonstrated that in this climate no system of ventilation can be successfully operated by itself and independently of the method of heating that may be adopted. It is, in fact, a vital element of success that the two systems must be most intimately combined, for they are clearly interdependent, and when properly applied are so interwoven in their operation and results that disunion is certain to bring about failure. For the purpose of ventilation, the fan was first applied upon a practical scale about the middle of this century, but only to a limited extent, and it was not until the fan and steam heater in marketable form were introduced by B. E. Sturtevant, that the so-called "Blower System" became a reality. This system is at once practical, successful and economical; for air being the natural conveyor of heat, it may, when properly warmed and supplied, perform the double office of heating and ventilating. As applied, the Sturtevant system forces the air into the apartment by the pressure or plenum method. When a fan is arranged to exhaust or withdraw the air from an enclosed space, the term vacuum, or exhaust method, is almost universally applied.

There are many objections to the adoption of the exhaust method in this country, and, as a rule, it should be avoided. When exhausting, a partial vacuum is created within the apartment, and all currents and leaks are inward; there is nothing to govern definitely the quality and place of introduction of the air, and it is difficult to provide proper means for warming it. Under this system provision is often made for drawing the air across steam pipes placed opposite windows, with the expectation that the air will become thoroughly heated in passing across them. Such often fails to be the case, for the most direct course is taken by the air toward the existing vacuum, and only a portion of the heating surface is utilized. On the other hand, when air is forced in, its quality, temperature and point of admission are completely under control; in a word, the method is positive; all spaces are filled with air under a slight pressure, and the leakage is outward, preventing the drawing of polluted air into the room from any source. But, above all, ample opportunity is given for properly tempering the air by means of heaters, either in direct communication with the fan itself or in separate passages leading to the various rooms. —From B. F. Sturtevant Co.'s Treatise on Ventilation and Heating.

GENERAL PRINCIPLES OF THE GAS ENGINE.

The general principles of the gas engine are explained in an article by E. W. Roberts in a recent number of Machinery, from which the accompanying illustrations are reproduced.

It will be necessary to briefly consider the series of operations which take place in the cylinder of a gas engine. With the exception of the Diesel motor, described in the last issue of The Canadian Engineer, all gas engines now being manufactured employ the Beau de Rochas cycle. The series of operations which comprise this cycle was first proposed by M. Beau de Rochas in 1870. It was not, however, put into practical form until it appeared in the first Otto engine in 1876. For this reason it is quite frequently called the Otto cycle, although the honor of its conception belongs unquestionably to Beau de Rochas. There is also in use a modification of this cycle in which a portion of the necessary operations are carried on in a separate device or its equivalent in order to permit the entire cycle to be completed during one revolution of the crank-shaft instead of two revolutions as required in the Beau de Rochas cycle.

The series of operations which take place during the four piston strokes necessary for the completion of the entire Beau de Rochas cycle is as follows: During the first forward stroke, gas and air are drawn into the cylinder and this mixture—called the charge—is compressed into a space at the end of the cylinder into which the piston does not enter. Just before the piston reaches the end of the compression stroke, or in some engines just as it reaches the end of the stroke, the charge is ignited. The ensuing explosion gives rise to a sudden elevation of pressure and temperature and during the next forward stroke the products of combustion expand. Just before the end of the expansion stroke, the exhaust valve is opened, permitting the contents of the cylinder to escape to the atmosphere. The following return stroke clears the cylinder of burnt gases, more or less thoroughly, according to the design of the engine.

The foregoing series of operations will be better understood by reference to Fig. 1, in which the indicator diagram given by the engine is placed immediately over the cylinder. For convenience of reference, the stroke of the engine is divided into ten equal parts, and lines are drawn from the cylinder to the diagram. Similar letters refer to the same point of the cycle and the letters are primed upon the diagram and capitalized upon the crank circle. The suction stroke starts at (c), the charge being drawn through the valve (v). Upon the return stroke, the admission valve (v) is closed and the charge is compressed into

the space between the piston (P), when at the end of the return stroke and at the end of the cylinder; that is, into the compression space. The point of ignition is indicated upon the diagram at (d). As shown by the diagram, the pressure rises more rapidly at this point than during the early part of the compression stroke and at the end of the stroke the charge becomes

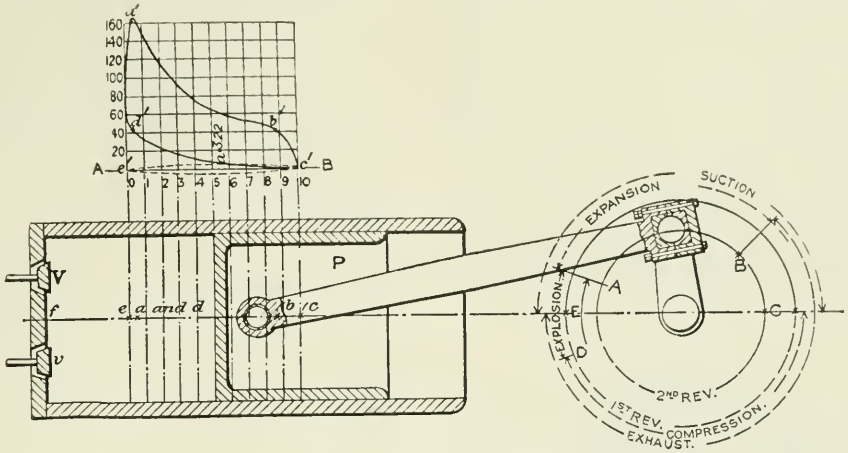


FIG. 1—SHOWING THE ACTION OF THE ENGINE.

fully inflamed, the pressure rising with great rapidity until the point of maximum pressure is reached, just before the piston starts on the expansion stroke (a), (b). The exhaust valve (V) opens just as the piston reaches (b), and from this point to the end of the stroke the pressure falls much faster than during true expansion. Upon the second return stroke, or while the piston is passing from (c) to (e), the products of combustion are driven from the cylinder.

The cycle is given in tabular form for easy reference:

1st Revolution—Forward stroke; suction. Return stroke; compression, ignition, explosion.

2nd Revolution—Forward stroke; expansion or power stroke. (Release).

The indicator diagram which is given in Fig. 1 is shown on a larger scale in Fig. 2. To have his engine produce such a diagram should be the goal of every gas engine designer. There appears to be no reason why such a goal may not be reached by everyone, since the diagram is an enlargement of one actually taken from an engine operating on the Beau de Rochas cycle. In the writer's experience the most successful engines operating on the market to-day are giving just such diagrams.

The notable points about the diagram shown in Fig. 2 are as follows: The compression curve is smooth and is a regular curve from the beginning of the compression stroke to the point of ignition. The gas ignited at (i), is fired just early enough to bring the point of maximum pressure at the beginning of the forward stroke, and the line (ab) indicating the rise of pressure lies at right angles to the atmospheric line (x), (y). The expansion line is smooth and does not show a series of steps as the pressure decreases. The release or point at which the exhaust valve opens is at (c), and it occurs at the proper moment to bring the point (d), where the expansion line meets the atmospheric line, directly at the end of the stroke. Wire-drawing on the suction and on the exhaust strokes would be indicated by a line similar to (xsy). The writer is aware that there is some difference of opinion regarding what constitutes an ideal gas engine diagram. This is especially true with reference to the point of stroke where ignition should take place. The majority are in favor of such a diagram as is recommended.

The diagram shown in Fig. 3 is a puzzling one. The wavy appearance of the expansion line is produced, not by conditions within the engine itself, but by the vibration of the indicator spring. A somewhat similar diagram might be expected from a badly mixed charge, in which case the rising side of the wave would be much steeper than the falling side.

Fig. 4 is reproduced from an actual diagram, and shows the effect of late ignition, which takes place at (i) after the piston has started on the power stroke. The amount of work which is lost because of the delayed firing is indicated by the area enclosed within the dotted line at the left of the diagram proper. No better argument for early ignition could be given.

When the mixture of gas and air is exploded at atmospheric pressure the resultant action of the gases depends upon two conditions, one of which is the quality of the combustible gas, and the other the proportionate amount of this gas to the air contained in the charge. A series of experiments made by Dugald Clerk, the well-known English gas engine expert, gave results which show the action of these mixtures. Mr. Clerk employed for his experiments the apparatus illustrated in Fig. (1). A chamber E, 7 inches in diameter by 8½ inches high, contains the mixture to be tested. A steam-engine indicator I, was attached to the explosion chamber E and the drum of the in-

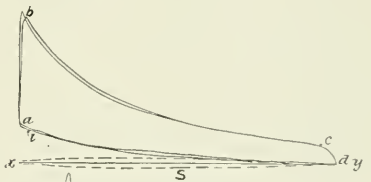


FIG. 2

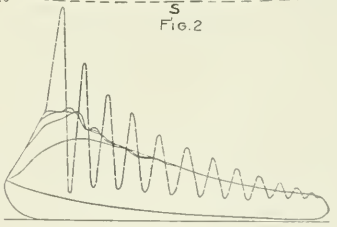


FIG. 3

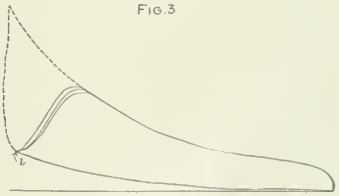


FIG. 4

dicator was operated by clock work as shown. The power to run the clock train was supplied by the weight W, and the speed regulated by the fan (F). By means of this arrangement, the pressure exerted in the chamber (E) was transmitted to the piston of the indicator, which in its turn raised the pencil (q). In the conduct of the experiments a carefully measured and proportioned mixture of gas and air was drawn into the chamber

(E), and the gases fired by means of an electric spark. The drum having already been set in motion, the pressure of the gas exerted on the indicator piston, compressed the springs raising the pencil (q). The pencil left a record upon the drum in the form of a curve somewhat similar to the upper portion of the ordinary gas engine diagram; vertical distances, measured on the line (xy) representing pressures and horizontal distances measured on the circumference of the drum representing intervals of time. With this piece of apparatus the successive alterations of pressure, from the time the gas was ignited until it had reached a pressure closely approaching that of the atmosphere, were determined. Nine of the curves thus obtained are shown in Fig. 10, and they illustrate the action of one variety of gas when mixed with air in various proportions. The different curves may easily be distinguished by the aid of the letters a, b, c, etc., which are placed at each end of the diagram.

Curve	a	b	c	d	e	f	g	h	i
Volumes of air to one of gas....	14	13	12	11	9	7	6	5	4

In this figure, only that variation of pressure which takes place during the first second is shown. The line (x y) is divided into twenty equal parts, each one of which represents a lapse of

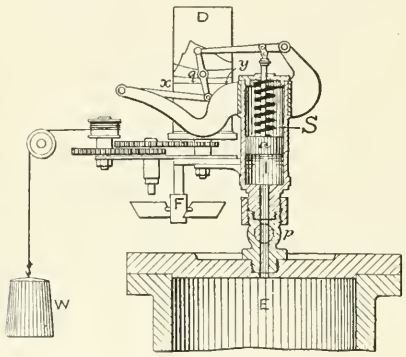


Fig. 5.

.05 second. The distance between each horizontal line represents a difference of pressure of five pounds. The time is measured from the moment when ignition takes place as indicated by the rise of pressure.

A careful study of the curves will show that when the mixture is weak in gas, the rise of pressure is very low, the time between ignition and the moment when the gases reach their maximum pressure being nearly .45 seconds for curve (a) and but .04 seconds for curve (g). This lapse of time indicates very closely the fraction of a second it takes for the gas to become one entire mass of flame, or to express it differently, the time required for full inflammation. The rate at which the pressure rises after ignition is indicated by the inclination of the curve. This inclination is of course very steep when inflammation is most rapid, and the inclination decreases as the rate of inflammation is lowered, the curve becoming more nearly parallel to the lines (xy). The rate of fall of pressure is indicated by the inclination of the line beginning at the point of maximum pressure and continuing to the right of the figure. This rate of fall is not shown as far as the point where the pressure of the mixture reaches that of the atmosphere. It may be stated that this point was reached approximately 1.88 seconds after the time when the ignition took place

It must not be thought that when the mixture is totally inflamed the gas has been entirely consumed. A peculiarity of such mixtures as this is that at the high temperatures produced in the gas engine a certain proportion of the gas remains uncombined with air and is not burned until a lower temperature has been reached. The effect of this phenomenon, called dissociation, is that heat is constantly being added to the mixture by this late combustion, keeping the pressures upon the expansion line much higher than could be obtained without it, under the conditions which are present in the cylinder. This phenomena is no detriment to the operation of the engine, but is rather in the nature of an assistant. It must not be thought that the mixtures of gas and air which give the most violent explosions and consequently the highest initial pressures are the most economical to use. An illustration of this is given in the table shown below, the data being taken from the curves in Fig. 6:

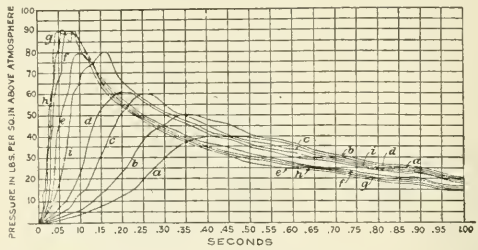


Fig. 6—Showing Effects of Explosions.

1	2	3	4	5	6	7	8
Volumes of air to 1 volume gas.	Proportion of gas in mixture.	Maximum pressure in lbs. per sq. in.	Area of piston to each cubic inch of gas.	Total maximum pressure per cubic inch of gas.	Pressure per sq. in. .2 seconds after maximum.	Total pressure to each cubic inch of gas .2 seconds after maximum.	Mean pressure on 1 sion for first .2 seconds after maximum.
14	1-15	40	15	600	31	465	532
13	1-14	51.5	14	721	40	560	640
12	1-13	60	13	780	42	546	663
11	1-12	61	12	732	44	528	630
9	1-10	78	10	780	44	440	610
7	1-8	87	8	696	47	376	536
6	1-7	90	7	630	52	364	497
5	1-6	91	6	546	50	300	423
4	1-5	80	5	400	46	230	315

Although the above table shows what would take place in an engine having no compression, and which draws the charge in for about half the stroke and then ignites it, it is of assistance to the designer in judging of the action of gases and in choosing the best mixture for a given engine. That proportion of gas to air which gives the highest pressures for the quantity of gas used, is undoubtedly the best. For instance, let the distance between the end of the cylinder and the piston be exactly one inch; then there will be one square inch on the surface of the piston for every cubic inch contained in the above space. In order to calculate the highest pressure which will be given with a certain quantity of gas proceed as follows: If the mixture contain one volume of gas to seven of air, there will be eight cubic inches of the mixture for each cubic inch of gas, and in a layer one inch deep the surface of the layer will be eight square inches. Since in the preceding table the maximum pressure for a mixture of the above proportion is 87 lbs. per sq. in., the total pressure exerted by each cubic inch of gas is $87 \times 8 = 696$ lbs.

That mixture which gives the best mean pressure for the first .2 sec. is that which gives 663 lbs. mean pressure to each cubic inch of gas. This mixture is that containing 1 volume of gas to 12 of air. Could the power stroke be considered as taking place without increase of volume, the pressure given in column 7 would be that remaining at the end of .2 sec. and that given in column 8 would be the mean pressure for the same length of time. Thus the figures in column 8 give a means of comparison of the powers to be obtained with the corresponding mixtures indicated in column 1. For instance, that mixture having one volume of gas to 13 volumes of air has more than double the power of the mixture containing one volume of gas to four volumes of air, the ratio being 640 to 315, the power considered being that available during the first .2 sec. after maximum pressure. Do not imagine that an engine could operate without increasing the volume of the cylinder; this assumption is taken as a convenient means of comparing the values of the various mixtures. It is important that in each of the above cases the gas be considered as if it gave its maximum pressure at the beginning of the stroke.

The Maritime Spice and Coffee Co., which has lately been organized at St. John, N.B., has ordered a 40 h.p. engine and boiler from the Robb Engineering Co.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS IN TORONTO.

The International Correspondence Schools, of Scranton, Pa., have just opened an office in the Temple Building, Toronto, No. 413, where they will make their Canadian headquarters. At these offices they have every facility for explaining their new system of education, and E. A. Seitz, the superintendent of the schools for the Dominion of Canada, tells us that all interested in technical education will be heartily welcome to examine their work, and look over the instruction and question papers of the different courses of instruction. There are two features in connection with the establishment of these offices of the International Correspondence Schools in Toronto, which are claimed to prove of great benefit to seekers after technical information along trades or profession lines. First, the schools propose giving a course of lectures for the benefit of students and friends, on the subjects of Electricity and Steam Engineering. F. Philip, the well-known superintendent of the mechanical department of the T. Eaton Co., will give a number of practical talks in connection with this series of lectures. Similar discourses, from a practical standpoint, will be given by others prominent in the various branches of engineering in Toronto. These lectures have no connection with the regular correspondence course of instruction carried on by the schools. The schools will also have at their Toronto offices complete sets of the instruction and question papers of all of their courses of instruction, handsomely bound. The range of subjects covered by these volumes will, the schools claim, make this the best technical reference library in the city. The students of the schools in Toronto will have the privilege of using this reference library at any time, the offices being open during the day and until 10 o'clock in the evening. The International Correspondence Schools have met with great success in their field of work. They state that they now have $1,500,000 invested in carrying on this system of education. They have over one thousand employees, and the buildings of the schools at Scranton, Pa., were erected at a cost of $250,000. In Canada alone the schools at present have over three thousand students and graduates. The remarkable success of the International Correspondence Schools is due to the fact that they give the kind of education needed. They enable men to pass the dead line of mediocrity, and make their way to the best positions in the engineering trades and professions. The schools point with pride to the army of students whom their instruction has placed in independent positions. The International Correspondence Schools claim to have solved the problem of how to educate the people. That problem, briefly, is how to put within the reach of the wage-earner the kind of education that will qualify him to climb the ladder of success. They believe that they have a perfect system, and it will well repay any wishing to better inform themselves along the lines of their work to examine into the practical results that have been accomplished by this system of study.

A TEST OF MECHANICAL DRAUGHT.

The possibilities in the way of reduction of fuel cost in modern boiler practice by the introduction of mechanical draught, are well exemplified by the accompanying results obtained at the United States Cotton Co., Central Falls, R.I. This record covers a period of 52 weeks, during which the number of hours run was 2,998, and the average indicated horse-power was 1,543.84:

Kinds of Coal.	Pounds burned.	Cost.
Buckwheat	6,074,400	$7,316 89
Anthracite	1,173,826	800 34
Cumberland	565,906	836 00
Total	7,814,132	$8,953 23

Cost per ton, $2.29. Cost per I. H. P. per year, $5.80.

Composition of Mixture:

Buckwheat	78 per cent.
Anthracite dust	15 per cent.
Cumberland	7 per cent.
	100 per cent.

The plant consists of three Babcock & Wilcox boilers of 325 rated h.p. each, a total of 1,005 rated h.p. The engine is a cross-compound Harris-Corliss, developing as will be noted, an average of 1,543.84 indicated h.p. The remarkably low fuel cost of $5.80 per I. H. P. per year in a plant without economizers, is primarily due to the employment of a low grade mixture costing only $2.29 per ton, the burning of which has been rendered possible by the introduction of mechanical draught. The draught of the chimney, which was previously employed, lacked the intensity necessary to the free combustion of this fuel, and as a consequence it had been necessary to use Cumberland semi-bituminous coal. The installation of the fan, costing less than $600, brought about an annual saving of no less than $6,500 in the fuel bill. The fan, which was built by the B. F. Sturtevant Co., of Boston, is provided with a direct attached engine, the speed of which is regulated by a device of the Sturtevant Co.'s chief engineer, Thos. P. Burke, whereby a slight change in the steam pressure alters the speed of the fan, and consequently the intensity of the draught, and brings the pressure back to normal. As a result, it is claimed that the steam pressure remains almost constant.

THE TURBINE STEAMER.

At the meeting of the British Association for the Advancement of Science, held at Dover, a paper was read by the Hon. Charles Parsons, the inventor of the Parsons' steam turbine, in which he said that the compound steam turbine engine had been so fully described in the proceedings of the Institution of Civil Engineers and the Institution of Mechanical Engineers and the Institution of Naval Architects that it was only necessary to refer to its leading features when designed for the propulsion of fast passenger vessels. Generally speaking, it might be said that the larger the size of the propelling machinery of the steam turbine class the more favorable are the conditions for securing the highest degree of economy in steam with a minimum of weight and the greater the simplicity of the machinery. For fast passenger vessels, and especially for cross-channel service, the turbine system of propulsion offers great and important advantages over the ordinary screw or paddle engines. In the first place, the steam consumption of the turbine engines is no more—perhaps somewhat less— than the best ordinary triple compound engines. The weight of engines, shafting and propellers is under one-half that of ordinary screw engines, shafting and propellers, and under one-third that of ordinary paddle engines of the same power, so that there is much less weight to be propelled; besides this, the hull itself may be of lighter structure than is admissible with ordinary engines owing to the absence of racking stresses from the machinery. With turbine engines no lubricant whatever enters the steam part, so that the boilers become much less charged with oil than is the case with ordinary engines, and express water-tube boilers of the smaller tube type may be maintained in satisfactory working conditions for long periods; and, further, it is understood that the Board of Trade will be prepared to so modify their system of periodic inspection as to permit of such boilers being used for regular cross-channel service. But perhaps the most important considerations are the increased comfort to passengers, owing to the absence of vibration and a remarkable smoothness of motion analogous to that of a sailing vessel, also the greater depth at which the propellers are placed below the surface of the water, reducing the liability to racing of the engines, which enables the speed of the ship to be maintained in heavy weather in a way that is totally impossible in the case of ordinary screw or paddle vessels. A model was exhibited in the hull of a proposed cross-channel boat of 30 knots sea speed in moderate weather. If a service of 30 knot vessels were placed on the Newhaven and Dieppe line, it would become the fastest route from London to Paris; also if the system were properly carried out as suggested, the time on the Dover and Calais route between London and Paris would be shortened by about half an hour, and the duration of the sea passage much reduced. The draught of water with turbine engines does not necessarily exceed that of paddle-wheel vessels, and, as turbine engines are more readily and quickly manipulated than ordinary engines, and each side of the propelling machinery can be put ahead or astern independently, the manoeuvring power is practically equal to that of paddle-wheel propelled

essels. The particulars of the proposed 30-knot turbine boats are as follows: Length, 275 feet; beam, 30 feet; depth (moulded) 13 feet 1 inch to main deck, 21 feet to awning deck; draught, 9 feet 3 inches (about): displacement, 1,000 tons (about); speed, 30 knots; i.h.p., 18,000. Professor Dunkerley, in the discussion on Mr. Parsons' paper, gave some details of the trials made, by Professor Ewing, of Cambridge, with the Turbinia, in which the speaker had also taken part. From the experience he had gained he then came to the conclusion that the steam turbine invented by Mr. Parsons would play a most important part as the motor of the future. Since that time further improvements have been made for marine propulsion, and he was now looking forward to the time when the crude instrument known as the reciprocating engine would be almost a thing of the past. The difficulty met with in going astern had been reduced. Mr. Barker, of Cambridge, the engineer to the Cambridge electric light station, bore testimony to the desirability of the steam turbine and the very small amount spent on repairs and renewals. This he gave as the result of a six years' experience. Captain Lloyd stated that in a preliminary trial of the day previously an Elswick destroyer with Parsons' turbine machinery had made 32 knots. He referred to the advantage given in a war vessel by the complete absence of vibration in regard to laying guns accurately.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The regular meeting of this society was held on Thursday evening, November 23rd, in the rooms of the society, 112 Mansfield street, Mr. St. George, vice-president, in the chair. After the reading of the minutes by the secretary, Prof. C. H. McLeod, a brief discussion took place as to suitable places for holding the next annual meeting; a lecture was delivered by Professor R. B. Owens, of McGill University, on the "Electrical Transmission of Power," the first of a series of lectures on the same subject, to be given during the winter.

Professor Owens commenced by stating that a distinction should be drawn between the "transmission" and "distribution" of power, the former referring usually to the transfer of energy over distances of five miles and upwards, and the latter to the transfer of energy in and about buildings, for lighting, and tramway service in cities, etc. The present lectures will deal with the problems of power transmission rather than those of distribution. He stated that as the development of power is distinct from its transmission and distribution, and had often been treated in previous papers before the society, it would only be considered incidentally.

Perhaps the first long distance transmission of power by electrical means was effected by Marcel Deprez, who nearly twenty years ago transmitted some 3 h.p. a distance of 25 miles over ordinary telegraph wires at a pressure of 2,000 volts, and obtained at the motor about 30 per cent. of the energy expended, but it was not until 1890 that the full capabilities of electricity, as a means of transmitting power to great distances, was appreciated. That year, in connection with the Frankfort Exhibition, some 200 h.p. was transmitted by 3-phase alternating currents at a pressure of 8,500 volts from Leuffen to Frankfort, a distance of 110 miles, with total losses of only about 30 per cent. Reference was made to the greatly increased use of alternating currents for power transmission, and distribution in recent years, but attention was also called to the many sources of trouble which a manager of an alternating current plant has to contend with, such as diminution of machine capacity with power factor of load, etc., many of which, he said, would disappear were continuous currents used. Several continuous current transmission plants in Europe were referred to. The general characteristics possessed by standard direct and alternating current apparatus were then discussed, and the usual methods for obtaining efficiency regulation, temperature, etc., of the machines given. His remarks were illustrated by large wall diagrams, showing the analysis of losses in several machines, efficiency and regulation curves, etc., under different conditions. Generally speaking, a large amount of copper and a small amount of iron mean good efficiency at light loads, but poorer regulation. With the majority of Canadian waterpower plants only maximum efficiency need be considered, as there was generally a surplus of power. Attention was called to the fact that in direct current generators, the multi polar type had nearly if not quite displaced the older bi-polar form, the reason being better commutation and slower speeds. The Lamme form of cross-connected armature was described and its advantages pointed out. A number of lantern slides were here shown, illustrating the various standard types of electrical machinery now in use, among them being a 1,500 k.w., double current generator of the Chicago Edison Co., a 1,500 k.w. revolving armature 2-phase alternator, used in the Snoqualmie Falls transmission plant; a 750 k.w. 3-phase revolving field alternator, as used at Lachine; a 2,000 h.p. inductor type of generator as used at Chambly, and several typical water-power transmission plants, as the St. Anthony Falls plant, the Mechanicsvilles (N.Y.), and the Big Cotton Wood plant, near Salt Lake City. In discussing the arrangement of apparatus in the generating station, among other points, the lecturer advised that exciters be all independently driven. Diagrams, showing the arrangement of winding for single polyphase generators and motors, were then shown. Attention was called to the importance of E.M.F. wave form in the parallel operation of alternators and in the operation of synchronous and induction motors and a number of actual wave forms were shown as obtained in the laboratories of McGill University. Means of independently varying the E.M.F. on feeders were then discussed and the Stillwell regulator described. Compounding of alternators for non-inductive load was then described, as also the recent composite wound revolving field alternator of the General Electric Co., which compensates for inductive as well as for non-inductive loads. The exciter armature is placed on the same shaft with the generator fields. A.C. current taken from series transformers placed in the line is passed into the exciter armature by means of suitable slip rings setting up a rotary magnetic field of the same period, but opposite in direction to the rotation of armature, thereby producing stationary poles in space. When an inductive load is put on the generator, the resulting lagging current has the effect of shifting these poles in such a manner as to increase the induction through the whole armature, thus raising the E.M.F. of the exciter and consequently the main generator E.M.F. Station devices, for indicating the E.M.F. at the end of the line, were then considered, and the Mershon compensator described, which allows for the inductive as well as the ohmic drop in the line. The difficulties of parallel operation of alternators, when driven by steam engines, were pointed out. The regulation and output of alternating current machinery, as effected by the power factor of the load, was then fully discussed and explained by means of suitable diagrams. The connection of several typical systems, 3-phase, 2-phase, mono-cyclic, etc., was also shown.

The next lecture, it was stated, would deal with methods of handling high tension currents, high tension transformers and the methods of line calculation.

A vote of thanks was extended to Professor Owens for his lecture.

The Civil Engineers' Club of Toronto held its regular monthly meeting at the Rossin House on the evening of the 7th ult. The following were present: Messrs. Canniff, Chewett, Chipman, Clement, Duff, Galbraith, Hanning, Hertzberg, Jennings, Smith, Speight, Spry, Stewart, Temple, Tully and VanNostrand. The topic of discussion for the evening was "The Necessity for a Topographic Survey of Canada." A congratulatory address to the Canadian Institute was adopted, the Institute having now been in existence fifty years. The trunk sewer problem will be discussed at the next meeting.

THE ROBERTSON CATCH BASIN.

Imitation is said to be the most sincere form of flattery, but when it goes as far as infringing on a patent it is time to call a halt. The deserved popularity of the G. A. Robertson catch basin tempted a foundryman in a western town to make up some catch basins on the exact lines of the Robertson, but without the trap feature, which is of vital importance. Steps have been taken to prevent a repetition of this illegal action, and the patentees wish to warn anyone else from following a similar course. The Robertson basin's reputation is steadily increasing, and quite a number of municipalities are adopting this basin for their sewage system. Among orders recently received are, Delorimier, Outremont and Montreal Junction.

COKE FROM NOVA SCOTIA COAL FOR USE ON RAILWAYS.

Numerous experiments have been made with the coke manufactured in Halifax by the People's Heat and Light Company as a locomotive fuel on the Intercolonial Railway. Lucious Tuttle, president of the Boston and Maine Railway, speaking of the introduction of similar coke on that railway system, says: "Coke as produced by the New England Gas and Coke Company, is a perfect locomotive fuel, and we are changing over our locomotive equipment so as to adapt same to the burning of coke as rapidly as we can get engines into the shops. This process is naturally slow at this season of the year, when every engine is in use. We expect to have 50 locomotives changed over this summer and 100 before next January, unless some new conditions arise which we do not anticipate. We already have about a dozen changed over and are using most of them in our suburban service between Boston, Gloucester and Marblehead. We have one on our through Portland express, and it is fulfilling all our expectations. It costs about $50 to change over an engine by placing in water grates, which we find best adapted for the purpose. The coke creates such an intense heat that cast-iron grates are not serviceable. By building up our engine tenders we are able to run our engines from 125 and 150 miles without refueling, and we cannot do better than this with coal. Of course the great advantage in the use of coke is that it is dustless and smokeless. On the run from Boston to Portland there will hardly remain a handful of ashes, whereas, in the burning of coal almost three bushels of ashes would remain. The cost of coke is just about the same as bituminous coal, while the advantages are innumerable. Through the oiling of our roadbed and the burning of coke we will be able to give a passenger service as clean as electric roads. We estimate that the Boston and Maine will effect a saving of at least $100,000 a year that it now pays in damages by reason of fires from sparks. Coke as a locomotive fuel is only made possible through Mr. Whitney, for he sells coke as a by-product. If coal was turned into coke simply for the coke the cost would make its use prohibitive. The use of coke is just as economical for freight engines as for passenger, and when we can get to it, it will be used on both freight and passenger engines. The engineers and firemen much prefer it to coal, and understand its use. Bituminous coal requires constant firing, whereas coke only requires refiring about every twelve miles."

LITERARY NOTES.

The Locomotive Fireman's Magazine for November has a portrait of the Queen and a number of excellent views relating to the South African war.

The Canadian Magazine has issued a December number of unusual excellence. The front cover, "The Golden West," is the finest that has ever appeared on a Canadian publication.

The Street Railway Journal's convention number (October) contains 156 pages of reading matter, 284 pages of advertisements and each copy weighs 4 lbs. 10 oz. Our enterprising New York contemporary bulks large in the eyes of its readers.

The Prince Edward Island Magazine, Charlottetown, has in its November issue a very clear photo-engraving of the P.E.I. contingent for South Africa, and a very fine looking squad of men the islanders are. This magazine continues its interesting sketches of P.E.I. history.

The Use of the Slide Rule is a pocket sized volume, cloth bound, by F. A. Halsey, associate editor of The American Machinist. It contains a hundred pages of valuable advice and suggestions, and is well illustrated. D. Van Nostrand Co., New York.

Everyone who has ever planned a house or ever intends to do so, and these classes include all mankind, will take a great interest in Keith's Architectural Studies. The Moderate Cost Houses in Vol. 2 range from $800 to $1,200. W. J. Keith, architect, Minneapolis, Minn.

"The Methodist Churches of Toronto" is the title of a substantial volume illustrating and describing the growth of the Methodist churches of the Ontario capital, starting from the days of Governor Simcoe, and carrying the story down to the present day. The work is dedicated to Rev. Dr. Briggs, whose ability and integrity as steward of the Methodist Book room for many years have been so well recognized, and it contains in addition to 19 engravings of the 36 churches in Toronto, short biographical sketches of well known Methodists to the number of about 300. The editor and compiler is Thomas E. Champion, author of the "History of the Royal Grenadiers," the "Anglican Church in Canada," and other works, besides many valuable contributions to our magazine literature. The present work will be an instructive contribution to the already respectable bulk of Canadian Methodist literature.

The contributors to the December Ladies' Home Journal include Finley Peter Dunne (author of "Mr. Dooley"), Rev. Cyrus Townsend Brady, Ian Maclaren, S. T. Pickard, Mrs. Burton Kingsland, Edward Bok, George W. Cable, Albert W. Smith, Dan Beard, Franklin Fyles, Sara Beaumont Kennedy, and a half-score of other equally well-known writers. To the pictorial embellishment of the same number A. B. Frost, W. L. Taylor, H. C. Christy, Frank O. Small, Walter Russell, Lucius Hitchcock, and others have contributed their best efforts. The Christmas Journal covers an unusually wide field of interest. The great festal day is the theme of carol, story and pictures, and of various practical, useful articles, while numerous topics that are uppermost in the minds of women and helpful in the conduct of the home, are practically discussed. By The Curtis Publishing Company, Philadelphia. One dollar a year; ten cents a copy.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The monthly educational meeting of the Hamilton branch of the C.A.S.E. was held on Tuesday evening, November 21st. The increased attendance was such as to assure the officers of the success of their experiment in devoting one meeting a month to educational topics, and the indications are that all interested in mechanics and engineering will take advantage of these meetings during the coming winter. The subject of the first paper was "Powers of Numbers, and Square and Cube Root," being one of a series on Mathematics, given by C. R. T. Fessenden, of the Westinghouse Company. The fact was emphasized that an essential qualification of the modern engineer was the ability to calculate areas and cubic contents, and to do this it was necessary that he have a knowledge of square and cube root. Mr. Fessenden gave rules for measuring and obtaining areas of circles, squares, triangles, irregular figures, etc., and in answer to a question explained the method of calculating the difference between a square and circular inch. A hearty vote of thanks was tendered Mr. Fessenden. A feature of the meeting was the distribution of a leaflet on "Fractions and Decimals," the first of a series being issued by the Ontario Executive on educational topics. The next meeting of this nature will be held on December 19th, and an invitation to attend has been extended through the local papers to all interested in mechanics, engineering, electricity, etc.

WATERMAIN SCRAPING.

The pipe cleaning operation was resumed last summer by the city engineer of St. John, N.B., with almost the same apparatus as in the preceding year. After carefully studying the action of the cleaner, and giving it several runs it was found that an improvement could be made in the scraper, which was accordingly done, and each arm fitted with a steel cutter which would not clog. It was also found that the arms could be stiffened without any risk of the machine sticking, and this was accordingly done. This scraper cut through all the deposit and right into the bare iron, an inspection at the termination of the work having shown that only the scars or imprints of tubercles remained on the interior surface of the pipe, and it was almost as smooth as when first made. The whole amount of the material removed was not measured, as the flushing branches delivered into the brooks, and the supply of water having been abundant the dirt was generally carried off in liquid form. An estimate may be had by bearing in mind that the average thickness of the deposit was fully three-quarters of an inch and the length of the main 23,000 feet. It will thus be seen that about 335

cubic yards were removed. In the Marsh Creek at the terminal flushing pipe, quite an extensive bar was formed by the material discharged from the main, and the current carried a large quantity away. When flushing into Little River by means of three different branches within one mile of Silver Falls the water of the falls assumed the color of strong coffee, and Major's Brook looked like ink at its confluence with the Marsh Creek, though it had received the flushings of the main 7,500 feet further up. These facts are given to show the impossibility of measuring the quantity of material taken out of the pipe. At No. 3 Hatch Box, where the cleaner had been taken out fifteen times when cleaning the upper end of the main, 108 bushels of heavy material, which would not flow off by the drain, remained, and had to be taken up in buckets as it accumulated, but all the more pulverulent scrapings were carried off in the drain, and as stated, blackened the water of the brook upwards of a mile away. At the other hatch boxes where the current was much stronger, an aggregate of 44 bushels of heavy material had to be hoisted out. The improvement in pressure ascertained in the same manner as at the end of the 1897 cleaning, viz., by sending the whole city's supply through Nos. 1 and 2 and leaving No. 3 shut off during the test, amounted to eleven feet. That is to say, that the two pipes, whose combined capacity before the cleaning began was only equal to that of raising the water 80 feet, can at the present time supply the whole district and deliver up to a level of 141 feet above high water datum in the harbor.

The lightness of the cleaner is a great advantage, the entire weight being but 263 pounds, and the bulky portion being made of wood, which weighs less than the water itself, it floated along with the water. This quality was well exemplified when the broken portion was taken from the main as related in last annual report. The hatch boxes were of cast iron, consisting of a section of pipe with the upper half removable and secured in place by means of screw bolts and nuts, the flanges being gasketed with Tuck's 1¼-inch round packing, which adapted itself to all the inequalities of the casting and to the curved form of the flange. Each one weighed about 3,300 pounds, and required 26 square necked bolts, besides about 18 feet of Tuck's packing. On completing each one, the pit was walled up with dry rubble and covered with timber, outside the city. Inside the city the covering was arched in masonry and cement, and an iron manhole left in the crown; the manhole being large enough to pass the cleaner through. The force employed to operate the cleaner consisted of a foreman, a mechanic, two watchers, six assistants and two express teams and drivers.

FIRES OF THE MONTH.

Nov. 2nd. Murray's planing mill, Winnipeg, Man.; damages, $12,000.——Nov. 3. The barrelling department of the Sun Oil Co., Hamilton, Ont.; loss, $6,000.——Nov. 4. Ontario Power & Flats Co., Toronto; the damages amounted to $17,000, divided among W. Spanner & Co., Gilchrist & Co. and Fraser & Co., woodworkers.——Nov. 5th. Webster & Boyes' carriage factory, Napanee; loss about $1,600.——Nov. 5th. D. I. Hamlin's evaporator, Port Hope, Ont.; loss, $4,000.——Nov. 9th. MacNeil's sawmill, West Devon, P.E.I., wholly destroyed.——Nov. 10th. T. Peters, tannery, St. John, N.B.; damages, $40,000.——Nov. 12th. Viau & Bro. biscuit and candy factory, Montreal; loss, $300,000.——Nov. 15th. W. W. Gordon's planing mill, Glencoe, Ont.; total loss.——Nov. 22nd. R. T. Houston's sash factory, Tweed, Ont.; loss from $6,000 to $8,000.——Dilworth's elevator, High Bluff, N.W.T.; insurance, $12,000.

THE PRACTICAL MAN.

STANDARDS OF LENGTH.

The standard yard was first legalized in England, in 1824; this standard, however, was destroyed in 1834. The standard imperial yard "Bronze No. 1," was then prepared and legalized in 1855. Forty copies were made, and one of these, "Bronze No. 11," was presented to the United States by the British Government in 1856. At the same time another copy, known as the Low Moor Iron No. 57, was sent. These were accurately compared, before being sent, with the standard imperial yard, and the record of the variations sent with them. Although the Constitution of the United States empowered Congress to fix the standards of weights and measures, no legal standard of length was adopted until 1866, when a law was passed making the metre legal, the first and only measure of length legalized by the United States Government.

METRIC MEASURES.

The metric unit of length is the metre = 39.37 inches.

The metric unit of weight is the gramme = 15.432 grains.

The following prefixes are used for subdivisions and multiples: Milli = 1/1,000, Centi = 1/100, Deci = 1/10, Deca = 10, Hecto = 100, Kilo = 1,000, Myria = 10,000.

METRIC AND BRITISH EQUIVALENT MEASURES.

MEASURES OF LENGTH.

French.	British.
1 Metre	= 39.37 in., or 3.28083 ft., or 1.09361 yds.
.3048 Metre	= 1 foot.
1 Centimetre	= .3937 inch.
2.54 Centimetres	= 1 inch.
1 Millimetre	= .03937 inch, or 1-25 inch nearly.
25.4 Millimetres	= 1 inch.
1 Kilometre	= 1093.61 yards, or 0.62137 mile

MEASURES OF WEIGHT.

French.	British.
1 Gramme	= 15.432 grains.
.0648 Gramme	= 1 grain.
28.35 Grammes	= 1 ounce Avoirdupois.
1 Kilogramme	= 2.2046 pounds.
.4536 Kilogrammes	= 1 pound.
1 Tonne or Metricton, 1000 Kilogrammes	= .9842 ton of 2,240 pounds, 19.68 cwts., 2,204.6 pounds.
1.016 Metric tons, 1016 Kilogrammes	= 1 ton of 2,240 pounds.

MEASURES OF CAPACITY.

French.	British.
1 Litre (= 1 cubic Decimetre)	= 61.023 cu. in., .03531 cu. ft., .2642 gal., 2.202 pounds of water at 62° F
28.317 Litres	= 1 cubic foot.
4.543 Litres	= 1 gallon, Imperial.
3.785 Litres	= 1 gallon.

NEW CATALOGUES.

We have received Catalogue 64 of the Sprague Electric Co., which discusses Lundell Generators, direct connected and better types, from the Canadian agents of this company, Jack & Robertson, Montreal.

The Dodge Mnfg. Co., Toronto, Ltd., is sending out a catalogue illustrating a full line of power transmission machinery. This is a work of some 270 pages, and should be found very useful to superintendents of mills and factories, also to mill architects and mechanical engineers. The work not only illustrates and describes fully and completely transmission machinery, but it also provides complete dimension tables covering each line; so that work may be provided for and laid out accurately from the beginning. We think the Dodge Co. is to be congratulated upon the volume. The Dodge Co. makes a specialty of shafting, hangers, pulleys, friction clutch pulleys, friction couplings, self-oiling bearings, belt tighteners, rope driving, chain and sprockets, jack shaft equipments, etc.

The B. Greening Wire Co., of Hamilton, has just issued a catalogue on "Wire Rope" as the first of a series of special catalogues to be sent out soon. Besides being a price-list of all kinds of wire rope, it gives particulars of fixtures and appliances to be used with wire rope, and what we think a great many regard as most useful, a number of valuable tables as to the working, etc., of wire rope under different conditions. Inside the front cover is a telegraphic code to be used when ordering, and on the back of the book is a cut of the works showing the new power loom mill just erected. This catalogue will be followed by one of Wire Cloth and Perforated Metals, which is now in the press. The company will send any of these catalogues to readers of The Canadian Engineer, if they will say what department they are particularly interested in.

The Canadian Heine Safety Boiler Co. have sent us the eighth edition of their publication, called "Helios." It is a handsomely bound volume of nearly 200 pages, and besides giving a full description of the Heine boiler, also contains much information of a valuable nature from the pens of eminent writers regarding fuels, steam engines, and a number of tables and data for reference. Professional men, manufacturers and practical steam engineers will find it invaluable.

Machinists' tools and measuring tools describes the contents of Brown & Sharpe Manufacturing Co.'s new 140 page catalogue. It contains also much valuable information, such as reference tables, etc. It is beautifully illustrated, and no catalogue that has ever passed through our hands is more worthy of a place in the kit of the machinist or on the shelf of the buyer of fine tools. Many new lines have been added since their last issue of a general catalogue. In writing for this catalogue ask for No. 101.

Industrial Notes.

A new sawmill is to be built at Watford, Ont.

The Hamilton Distillery Co. has installed the Redpath-Reid automatic smoke consumers in its works.

A large brickyard is proposed at Orangedale, C.B., and it is said that the necessary site has been secured.

The Ontario Lantern Co., Hamilton, Ont., is building an addition to its works, 98 x 38 feet, three stories high.

The debentures for a new waterworks system at Calgary, N.W.T., have been signed and a contract will be let at once.

The city engineer of Toronto urges the city council to buy additional pumping plant to the extent of a ten million gallon pump.

John Duffy, St. John, N.B., has been awarded the contract for building a quarantine station at St. John, the price being $18,500.

Smith's Falls, Ont., has given C. T. Hookway, Syracuse, N.Y., the contract to build a trunk sewer in that town. The contract price is $17,590.

The new grist mill now in course of construction at Gagetown, N.B., will be owned and worked by J. H. Brown & Son, formerly of Apohaqui, Kings county.

G. P. Magann and Alex. Fraser, Toronto, and E. J. Fawke, and others, have been incorporated as the Magann, Fawke Lumber Co., Ltd.; chief place of business, Toronto; capital, $300,000.

R. H. McKee and T. H. Wright, J. A. Macrae, McLeod Stewart, Ottawa, and A. M. Perkins, Perkins Mills, Quebec, have been incorporated as the McKee Machinery and Lumber Company, Ltd.

T. J. Drummond, G. E. Drummond, J. T. McCall, C. E. Gudewell, C.E., Montreal; F. Thompson, Sherbrooke, Que.; G. Gudewell, New York, U.S., have been incorporated as the Lennoxville Waterworks; capital, $50,000.

J. McBurney, J. T. Beattie and T. A. Rowan, Toronto; and J. A. Coulter and Rebecca M. Morrow, Ingersoll, Ont., have been incorporated as the McBurney, Beattie Company, Ltd.; chief place of business, Toronto; capital, $40,000.

The International Correspondence Schools, of Scranton, Pa., offer special privileges in the way of reductions in the price of books and technical outfits to all students who enroll before January 1st, 1900. Circulars, defining these privileges, will be sent on application.

The Goldie & McCulloch Co., Ltd., Galt, Ont., is very busy, and during the week ending November 25, shipped several large safes and three car-loads of flour mill machinery to different parts of the Northwest Territories; one car-load of same to Lucan, one car-load of boilers, etc., to Hamilton, two gas engines, and several minor shipments.

The employees of the Jas. Warnock & Co., with the members of the firm, banqueted together in Polson's Hall, Galt. Many of the men had been employed for over a score of years by this concern; a total of 355 years was the record claimed by thirteen employees. F. H. Hayhurst, the manager, in his address, referred to the fact that for over a year night work was necessary to keep up to their orders.

Harriston, Ont., has voted a bonus of $20,000 to the Harriston Pork Packing Co.

The Cornwallis Valley Packing Co., Kentville, N.S., has been incorporated; capital, $30,000.

The removal of the Canadian Locomotive and Engine Co. from Kingston, discussed so often, is again talked of. The city council has not agreed to the $50,000 bonus asked.

F. W. Thompson, western manager of the Ogilvie Milling Co., reports that a Canadian foundry will put in a plant at Fort William, Ont.

The Toronto Electric Light Co. has equipped its new Heine boilers with the Jubilee shaking grate bars, each boiler requiring 60 sq. ft. of grate.

The plant of the Berlin, Ont., Rubber Co. was given a test on Nov. 16th. The special machinery was supplied by the Birmingham Foundry Co., Derby, Conn.

Application has been made by the Dominion Oil Pipe Line Co., Sarnia, Ont., for the reduction of the capital stock to $500,000, and to change the headquarters of the company to Toronto.

L. Page, liquid glue maker, is at the head of a company which is erecting a factory on Howe Sound, B.C., for the manufacture of glue and oil from the dog fish. R. J. Leckie, Toronto, is a member of the company.

A. O. Norton, Coaticook, Quebec, manufacturer of ball bearing lifting jacks, has added additional machinery to his plant, to keep up with the increasing demand for his product. He reports several large export orders received last month.

It is reported that the agricultural and implement works of Frost & Wood, Smith's Falls, Ont., are to be doubled in capacity next spring. A single English order recently received by this firm was for a thousand machines of the same kind.

The Canadian Rubber Co., Montreal, has placed contracts for a warehouse of large dimensions in that city. It is intended that the establishment will be 180 x 170 feet, occupying the entire block which faces Craig, St. Adolphe, Notre Dame streets and Papineau square.

In our advertising pages, E. Leonard & Sons, engineers, London, Ont., announce a new type of engine. This is a self-oiling automatic engine, adapted for either electrical or manufacturing purposes. We understand the firm will send a descriptive catalogue on application.

W. Currie, F. P. Currie, J. T. Shearer, Hon. J. A. Ouimet, J. Livingstone, Montreal, and T. E. Fee and E. S. Fee, St. Hyacinth, Que., have been incorporated as the Dufferin Falls Lumber, Pulp and Paper Company of Montreal, with a capital of $1,000,000; chief place of business, Montreal.

C. R. Whitehead has been re-elected president of the Montmorency Cotton Mills Co., of Montmorency Falls, Que. The company now employs 550 hands, and proposes to build a new mill next year to be devoted to the export trade. The new mill will ship cotton goods, chiefly to China and East Africa.

H. Pearce, Birmingham, Eng., H. Pearce, jr., Montreal; J. F. Beringer, T. E. Owens and Francis, Picton, Ont., have been incorporated as the Bloomfield Packing Co., Ltd.; chief place of business, Picton, Ont.; capital, $40,000.

Redpath-Reid automatic smoke consumers have been installed in the following plants among others: Mitchell Waterworks and Electric plant, Mitchell; American Rattan Co., Walkerton, Canadian Colored Cotton Mills, Hamilton; George Pattinson & Co., Preston; Lambton Woolen Mills, Lambton; Canadian Colored Cotton Mills, Merritton; Brighton Canning Co., Brighton, Ont., and Central Ontario Railway Co.

The Canada Foundry Co., which was incorporated last month with a capital of $1,000,000, has bought the St. Lawrence Foundry, Toronto, from the Rice Lewis Co., Ltd., to serve as a centre, about which will be built up the vast business in iron castings, especially for architectural work, which the company announces it will undertake. The first directors of the company are: E. B. Osler, W. R. Brock, W. D. Matthews, Toronto; Wm Hendrie, Hamilton, Ont.; F. Nicholls, T. W. Horn, Toronto and W. H. Winslow, of Winslow Bros., Chicago, who are said to be the largest architectural iron workers on the continent

A bonus of $50,000 has been voted to the proposed steel shipbuilding company at Collingwood, Ont.

The Brantford, Ont., Co-operative Pork-Packing Co. has bought a site on which to build its factory.

Robt. Lillie, foundryman, Perth, Ont., has sold out to James Bros. The new firm will make and repair ploughs, stoves, etc. The foundry will be managed by F. Deacon.

Sproatt & Rolph, architects, Toronto, have let the contract for installation of blast system of heating, also the plumbing of the Lever Co.'s soap factory, Toronto, to W. J. Maguire & Co., Toronto.

Early in January McGill University will open a new course of instruction for graduates in medicine in Public Health. Such a step as this is most encouraging to those whose aim is the improvement of sanitary conditions.

The Chalcraft Screw Co., of Brantford, capital $75,000, has been incorporated with the following provisional directors: E. Chalcraft, F. Chalcraft, E. L. Goold and C. Cook, Brantford, Ont., and George Randall, Waterloo, Ont.

The Department of Railways and Canals, Ottawa, is calling for tenders for constructing an additional section of the Trent canal, viz., that from Trenton to Frankton, a distance of nine miles. The work includes the deepening of the Trent river, between these two points, the construction of seven locks and seven dams.

The industries of Hamilton are steadily progressing. Among other extensions the firm of J. N. Tallman & Sons, successors to Wm. Hunter in the well known brass founding business, are now erecting an addition to their works which, when completed, will make it one of the largest and best equipped brass foundries in Canada. Among the specialties of the firm are phosphor-bronze, zinc, copper and aluminum, bronze castings, and anti-friction metals.

In the presence of a large number of the citizens Mayor Wilson formally opened the new buildings of the Victoria Hospital at London, Ont. A massive gold key was presented to the mayor by Thos. Gillean, jeweler, and the same gentleman also presented the hospital with a magnificent solid silver tea service. The architecture is colonial, and the architect, H. C. McBride, of London, was complimented highly on the results of his work. The buildings will cost completed about $100,000, and a saving of at least 25 per cent. was effected by letting contracts, and getting the building started last year before the rise in material took place.

At the national convention of ice manufacturers at Indianapolis, Ind., last summer, while the question of the best method of filtering was being discussed, one of the leading manufacturers made the statement that he had tried every scheme of which he had ever heard for cleansing distilled water from oil without satisfactory results, until about a year ago, when he put in an Austin Oil Separator, manufactured by the Austin Separator Co., Detroit, Mich. Since that time he has had absolutely no trouble, and has secured perfectly clear ice. As he used water distilled from exhaust steam, his experience will go far to clear up the problems which confront so many engineers who use exhaust steam, and have the troubles consequent to feeding oil in the boiler, or steam pipes where exhaust is used for heating. The Austin steam separator is also said to do equally good work in eliminating moisture from live steam.

Owing to the increase in its output the Atlantic Refining Co., Toronto, has decided that more central and commodious quarters are required. The company has leased for a term of years the premises formerly occupied by the Toronto Carpet Co. on the Esplanade at the foot of Jarvis street, and with the improved facilities for shipment, either by water or rail they will be in a much better condition for handling shipments. The Atlantic Refining Co. claims that its position in the oil trade is unique; it prides itself on being a thoroughly independent concern, outside of the combine, and its specialty is the supplying of lubricating oils made from Pennsylvania crude, and it is generally acknowledged that for the best grades of cylinder oil Canadian crude oil will not answer, the Pennsylvania stock being unrivalled for this purpose. The Atlantic Refining Co. will, in our advertising columns, deal more fully with its different wares.

Berlin, Ont., sewage disposal works are threatened by neighboring farmers with legal proceedings on account of offensive odors arising from the beds.

There having been granted $30,000 for the rebuilding of the interprovincial bridge at Portage du Fort, Que., $20,000 from the Federal Government and $5,000 each from the Ontario and Quebec Governments, work upon the new bridge is now going on

The largest contract for pipe and boiler covering given in Canada is said to be that just awarded by the Lady Superior of the Longue Pointe Asylum, Montreal, to the Clappison Pipe and Boiler Covering Co., of Hamilton, and now being filled under the supervision of J. H. Clappison of that firm. The main building is 3,000 feet long with several wings, and it will take a month to instal and complete the heating apparatus.

The offices and warehouse of the Fairbanks Co., Craig street, Montreal, are a model of order and attractive display. The show cases of machinists' tools, valves and special mechanical appliances strike the eye at once, and there are many novelties to interest the visitor. Some of these specialties of the Fairbanks Co. have been described in previous numbers, but the engineer and machinist visiting Montreal will find in the five stories of this warehouse many other things that will instruct them.

Another failure to be added to the list of bonus-hunters, is that of N. Commire, Fils & Co., foundrymen, in Maisonneuve, a suburb of Montreal. Mr. Commire was long in business in Montreal without achieving any very material success, and in 1896 moved to St. Jerome, under a bonus arrangement from that town. He remained there but a short time, and moved to Maisonneuve two years ago, making a new arrangement with the latter town. A demand of assignment has now been made upon the firm.—Monetary Times.

Electric Flashes.

Seamen, Kent & Co., Toronto, are installing a 60 light dynamo in their factory from the works of the Jones & Moore Electric Co.

The Canadian General Electric Co. is installing an electric lighting plant of 150 light capacity for the Georgian Bay Cement Co., Owen Sound, Ont.

Jno. Penman, Esq., Paris, Ont., is installing a model electric plant for the lighting of his residence, purchased from the Canadian General Electric Co.

The Canadian General Electric Co. have closed a contract with the Imperial Oil Co., Sarnia, Ont., for a standard 40 k.w. direct current generator, direct connected to Ideal engine.

C. M. B. Lawrence, proprietor of the Oakville, Ont., Electric Light Co., has purchased from the Canadian General Electric Co. a standard single phase alternator of 1,000 light capacity.

The Canadian General Electric Co. has received an order from the Acadia Edison Co., Wolfville, N.S., for two standard 25-k.w. multipolar direct current generators with switchboards, etc., complete.

New Westminster, B.C., has contracted with the Canadian General Electric Co. for a standard 150-k.w. monocyclic generator with switchboard, etc., for the supply of light and power throughout the city of New Westminster.

Wm. Kennedy & Sons, Ltd., Owen Sound, Ont., have purchased a 500 light electric plant from the Canadian General Electric Co., consisting of a latest type, Form H., multipolar generator with marble panel switchboard and wiring material for their works throughout.

The Nelson Electric Tramway Co., Nelson, B.C., has placed an order with the Canadian General Electric Co. for its entire requirements electrically, consisting of one standard 325-k.w. railway generator with panels, one 500 h.p. three-phase revolving field synchronous motor with panels, together with full complement of cars and motors. They have also contracted with the West Kootenay Power and Light Co., Rossland, B.C., for the power necessary to operate this plant

The Nova Scotia Carriage Co. has purchased a 100 light dynamo from the Jones & Moore Electric Co.

D. G. Whiddon, Antigonish, N.S., has placed an order with the Canadian General Electric Co. for a 500 light direct current plant.

The Jones & Moore Electric Co. shipped five motors to Vancouver, B.C., during the month, and find difficulty in filling their orders. The demand is much in advance of former years.

The plans for the new electric plant for the Toronto Rubber Shoe Mnfg. Co., at Port Dalhousie, Ont., were prepared by R. J. Parke, consulting electrician, Toronto.

The terms offered by the Niagara Falls Park Commissioners for the privilege of constructing an electric railway along the Niagara river have been rejected by the Fort Erie Electric Railway Company, and an alternative proposition is being considered

The Dartmouth Electric Light Co., Dartmouth, N.S., has placed an order with the Canadian General Electric Co. for a standard 30-k.w. single phase alternator with switchboard transformers and wiring complete.

The Canadian General Electric Co. is installing a standard 120 k.w. single phase alternator for A. Gagnon & Co., Victoriaville, Que. This is the second machine of this size and type which this company has installed during the past year.

The Montmorency Electric Power Co. is suing the Jacques Cartier Electric Light and Power Co. for $25,000 damages, and for an injunction restraining it from doing business in the city of Quebec, for which the complainants claim the sole right to supply electricity.

While repairing wires in the factory of the Union Carbide Co., Niagara Falls, N.Y., Nov. 25th, John Sheffield was instantly killed by coming in contact with the primary terminals of a switch, where he received a shock from a current of 2,000 volts. He was a scholarship man in electrical engineering.

The Dominion Iron and Steel Co. has placed an order with the Robb Engineering Co. for two 150-h.p. engines for electric lighting purposes. They have also recently bought from the Robb Co. a number of smaller engines and boilers for temporary use during the erection of their extensive plant.

Hon. F. Peters, ex-Premier of Prince Edward Island, and E. J. Fader, Vancouver, B.C., propose to turn to account the power of the tide in both the first and second narrows in Vancouver harbor, to operate an electric plant. They have applied to the Dominion Government for certain foreshore rights to enable them to proceed in the matter.

R. A. Ross, consulting electrical engineer, Montreal, has just returned from a professional tour through China, Japan, British India, and other eastern countries. He reports the electrical development of Japan as very complete, and the entire work in the hands of the natives who have been trained abroad. Mr. Ross states that a wave of electrical progress swept over India about a year and a half ago, and tramways are now to be seen in Calcutta, Bombay, Colombo and Madras, which are quite well equipped.

A meeting of the Toronto Street Railway Electrical and Mechanical Association was held last month, which was composed of representatives from all the different mechanical and electrical departments of the railway. The finances of the benefit fund were reported by Secretary Cox to be in a flourishing condition, and the sick and distressed members of the society have been well cared for. The following officers were elected: President, G. J. McCullough, chief electrician of the railway; vice-president, M. Power; secretary, William Cox; treasurer, R. Bunting.

The Canadian General Electric Co. has just received an order from the Trenton Electric Co. for a 75 light equipment of alternating series enclosed arc lamps, with automatic regulating transformers and switchboards. These are to be used for street lighting in Belleville, Ont., the current being taken from the three-phase transmission lines, coming from Trenton a distance of 13 miles. This is the third installation of this kind which is being put in in Canada; a 100-light capacity equipment having been installed in Sherbrooke, Que., and another 100 lights in Halifax, N.S., both of which are, it is said, giving eminent satisfaction

The St. Catharines Cold Storage Co. have installed a 20 h.p. motor of the Jones & Moore Electric Co.'s make.

The Jones & Moore Electric Co. shipped eight motors to the Winnipeg Street Railway Co. during the last month.

The Patent Exchange and Investment Company, on behalf of B. R. Dodge, Post Mills, Vt., U.S., inventor of the Dodge system of telephony, has applied for a charter to put in a telephone system in Toronto. The city engineer will report upon the scheme.

The second electric locomotive in Canada has been put in service on the Metropolitan Ry., Toronto. The locomotive was manufactured at the Baldwin works, Philadelphia, and weighs when completely equipped nearly 50 tons. The power of draught of one of these engines is fully equal to a large mogul engine, and a guarantee accompanies it that it is capable of drawing a 30-ton car up a grade of 9 in 100.

Port Dalhousie is to be electrically lighted from a plant now being put into the Toronto Rubber Shoe Mnfg. Co.'s works there. The machinery, which is supplied by the Royal Electric Co., provides for 10 arc lamps and 500 incandescent lamps for the village, and 20 arc and 600 incandescent lamps for the factory. There will also be a 10 h.p. motor for the elevator, and a 15 h.p. motor to drive the machinery in the factory, besides a 20 h.p. motor for the heating and ventilating plant.

Ahearn & Soper, electrical engineers, Ottawa, have orders for motors to the aggregate of 4,000 h.p. for the Dominion Cotton Mills Co.'s two mills in Montreal. These are of the Westinghouse induction type, and form the most complete and extensive electrical equipment of any cotton mill in the world. Among other electrical installations by this firm in Montreal are a 100 h.p. motor for the Dominion Oil Cloth Co.'s new factory; a motor for P. Lyall's marble works, and three motors for the Wire and Cable Co.'s new works in Beaver Hall Hill.

The Massey-Harris Co., Ltd., has decided to equip its Toronto factories with a modern system of electricity for light, heat and power. They have contracted with the Canadian General Electric Co. for two 100-k.w. direct current generators direct connected to Ideal engines; in conjunction with these they are installing generator and feeder panels, arranged for controlling the system of lighting throughout all the different departments. This plant will be one of the largest isolated installations in Canada.

The Electrical Maintenance and Construction Co., of Toronto, Ltd., which began business less than a year ago, under the management of P. H. Patriarche, has had a remarkably successful career, the business having expanded till it has now contracts in hand aggregating over $100,000. In view of the development of its business it has been found necessary to increase the capital stock from $20,000 to $250,000. Mr. Patriarche was with the Toronto Electric Light Co. for some time, in which connection he gained the knowledge which has enabled him to organize and rapidly extend the business of the new company. One of the contracts this company now has in hand is the Orillia power plant, which will be referred to in another issue.

Incorporation has been granted to the Lake Simcoe Navigation Company, Ltd., capitalized at $90,000. Among the incorporators are, J. C. McKeggie, J. McNairn, Edward Adamson and Wm. Paul, Toronto, and J. L. Ross, Aurora, Ont.

—The Royal Electric Co., Montreal, is installing in the head office of the Merchants' Bank of Canada, Montreal, two 50-k.w. direct connected generators with Robb-Armstrong engine complete with switchboards. These generators are to operate at 250 volts, and the building is wired for lighting to operate lamps at 220 volts, and also two Sprague elevators.

The Rideau Navigation Co. is having a passenger boat built by the Davis Dry Dock Co., Kingston, Ont. It is 112 feet by 28 feet, and draught 7 feet. The upper cabin is to be 84 feet long, and will contain 32 staterooms. The engines are triple expansion, 8½, 13, 21 and 14 inch stroke. A speed of 12½ miles is guaranteed. The cost will be $20,000. The Davis Dry Dock Co. is also rebuilding the steamer "Constance," of Gravenhurst, Ont., at a cost of $3,500.

Railway Matters.

The Railway Committee of the Privy Council has ordered a subway to be built at the Lansdowne avenue C.P.R. crossing in Toronto. The cost will be about $30,000, to be borne equally by the city and the railway.

Officers of the Morris, Portage and Midland railway, a projected line for which a charter has been issued, were elected in Winnipeg as follows: J. W. Kastner, president; G. F. Birney, Morris, treasurer, and G. A. Glines, Winnipeg, secretary.

It is stated that according to present plans of the C.P.R. the old freight sheds near the Queen's wharf, Toronto, will be converted into car shops. These extend from the garrison bridge east to Bathurst street, and are the old Toronto, Grey & Bruce depot. The new workshops will employ about 150 hands.

Judgment has been given in the case of Beemer vs. the Pontiac & Pacific Junction Railway Company. This was a claim for $400,494.21, representing $342,903.47, amount of a claim transferred to plaintiff by F. Ross representing the estate Ross, and also $57,590.74, amount due by defendant to plaintiff for cash advances. The defendant did not appear, and judgment was rendered in favor of plaintiff by default.

Efforts are being made to have the Kingston & Pembroke railway extended into the mineral belt of Quebec in the vicinity of Bryson, which now cannot be developed for lack of transportation. Twelve miles of track from the Kingston & Pembroke railway terminus at Renfrew would bring the line to Portage du Fort, and eight miles' further extension would bring it to Bryson, the county town of Pontiac.

Iron and Steel.

Rhodes, Curry & Co., Ltd., Amherst, N.S., will, it is said, build workshops in Sydney, C.B.

It is stated that local capitalists propose to put $100,000 into manufacturing saws in Hull, Que. It is the intention of the syndicate to work in conjunction with the Ottawa Saw Works.

The Abbott-Mitchell Iron & Steel Co.'s new works at Belleville, mentioned in previous numbers, will be in operation in a few days and will be perhaps the most modern plant of its class in Canada.

F. R. F. Brown, consulting engineer, has been appointed secretary of the board of directors of the Dominion Iron and Steel Company, of Sydney, C.B. He will represent the company in Montreal.

Merrickville, Ont., is negotiating with the Canadian Engine and Locomotive Works, Kingston, for their removal to that town. It is reported that a bonus of $75,000 has been offered the works to move outside Ontario.

The Hamilton blast furnace is now working the Robertsville and Martell iron mines, and the Zanesville mine, near Calabogie, Ont. The iron mines along the Kingston & Pembroke railway are said to be able to amply supply the demands of the Hamilton company.

The Hon. R. W. Scott is largely interested in the reopening of the iron mines on the Gatineau river, near Ottawa. It is said 200 men will be at once put to work, and are taking out for the Ohio market. Thirty years ago these mines were exclusively worked by the Hon. James Skead and others. The Gatineau mines are three in number, two on the west side of the river and one on the east side.

The directors of the Dominion Iron & Steel Co. met in Montreal, November 21st, the following directors being present: H. M. Whitney, Sir William Van Horne, R. B. Angus, James Ross, M. Dyer, Senator Mackeen and Messrs. Rogers, Pearson, and McLennan. Alfred Moxham, of the Lorraine steel works, near Cleveland, O., was appointed general manager. Mr. Moxham was formerly of Johnstown, Pa. Mr. Whitney says two of the four furnaces at Sydney will be in blast by the 1st of January next. The first of a fleet of 35 vessels, which will carry from Philadelphia to Sydney, C.B., upwards of 125,000 tons of structural steel, coke ovens, etc., began loading at that port Nov. 20th. This is material ready to be placed in position in constructing the blast furnaces, etc., at Sydney.

Mining Matters.

Rich finds of mica are reported as being opened up by J. Stewart at Cartwright, Newfoundland.

The Great Lakes Copper Co., a United States incorporation, is licensed to do business in Canada.

Seventy ovens are now turning out coke at the Acadia Coal Co.'s works, Stellarton, fifty at the back mines and twenty at the Foord pit.—Mining Record.

There is considerable activity in mica mining in the neighborhood of Ottawa. Munsen & Co., New York, are heavy buyers of mica through their Ottawa agents.

Joseph Lemieux, Charles Desmarais, F. X. Filteau and A. L. Laundry, Hull, Que., have bought a mica mine near Buckingham, Que. The claim bought is 700 acres in extent, and the price was $2,000.

At present the attendance of students at the School of Mining, Kingston, Ont., is the largest in the history of the school. After this session enlarging the school will probably be undertaken.

The Mumford improved boilers, which the Robb Engineering Co. has sent to British Columbia, have obtained such a good reputation for economy, that the Ymir Gold Mines Co., Ltd., Nelson, B.C., has ordered three of them for use at its mines.

Land in the township of Denison, south of the Creighton district, eighteen miles from Sudbury, Ont., in extent less than 200 acres, was sold last month to Dr. Ludwig Mond for $200,000. The vendors were R. J. Tough, of Toronto, and R. McConnell, and Mrs. McConnell, of Mattawa, Ont.

D'Arcy Scott, Ottawa, has bought at sheriff's sale the Walker plumbago mines at Buckingham, Que., for $70,000. The property is 1,200 acres in extent, consisting of plumbago deposits, with a factory and machinery for manufacture. In addition to the factory are quarters for employees, and a foreman's residence.

The Governors of McGill University have accepted the offer of Sir William McDonald (a cheque of $62,500), to found and endow a chair of Geology in the Faculty of Arts as a memorial to the late Sir William Dawson, emeritus principal of the University. The conditions attached to the gift were also assented to, namely, that an annuity of $2,500 should be paid to Lady Dawson during her lifetime.

R. R. Hedley, manager of the Hall mines smelter, Nelson, B.C., who spent several months examining Boundary Creek properties, says of the ores of the Boundary country: "I consider that possibilities are far greater in Boundary Creek district. There the variety is greater, and a perfectly self-fluxing ore is obtainable. Should the coal on development prove to be of good coking quality, and in sufficient quantity, a plant with a large capacity will treat ore as cheaply as anywhere on the continent. Even in bringing in coke at a cost of $12 per ton, laid down, I have no hesitation in saying that a 250-ton plant—two furnaces—using steam power, will smelt at a cost not to exceed $3.25 per ton."

An agreement has been made between the Ontario Government and a syndicate headed by Lloyd Harris, Brantford, and B. A. C. Craig, Toronto, by which the latter are to receive a concession of 2,000 acres in Dungannon, Monteagle, Carlow, Raglan and Brudenell, in Renfrew and Hastings counties, Ont. The concession embraces a series of locations in separate lots of 50 acres and over along the York branch, a tributary of the Madawaska river. In addition to paying the annual rentals as fixed by the Ontario Mines Act, the makers of the agreement are under penal bonds to spend $25,000 before September 15th,

1900; $50,000 within the next eighteen months, and $100,000 within the next three years. Of these sums it is provided that $3,000 shall be spent on experiments looking toward the production of aluminum from the rock in these locations, and a minimum of $25,000 on a plant for the manufacture of abrasive goods from corundum.

A number of practical tests are carried out each year by the staff of the Department of Mining and Metallurgy and the students of the mining course in their 4th year, in the metallurgical and ore dressing laboratories of McGill University. These consist of the milling and smelting of sample lots of ore, and are intended to apply as much as possible to the advancement of the mineral industries of Canada. At the present moment tests in concentration of low grade titaniferous and chromite iron ores, from the province of Quebec, are in progress, the success of which will have an important economic bearing. Different lots of the ore have been crushed in the various crushing machines of the laboratory, including the fine rolls, stampmill and Huntington mill. Experiments are now being conducted on these, with different sets of concentrating apparatus to determine the most suitable treatment for the ore. In connection with this work, a Browne hydrometric classifier, one of the latest additions to the ore dressing plant, is being made use of.

Personal.

A. E. Lewis, of the Atlantic Refining Co., left Toronto on the 29th ult. for Winnipeg and the Northwest in the interests of his company.

N. Hanson Greene, C.E., returned to Montreal recently from an extended trip through Central Ontario, where he has been engaged in reporting on proposed water power and harbor development works.

At the opening of the present session at McGill University the position of McDonald lecturer in Metallurgy and Assaying was left vacant by the resignation of John W. Bell, he having gone to California to take an important part in connection with a mining enterprise there. This vacancy has recently been filled by the appointment of F. W. Draper, M.Sc. Mr. Draper is a graduate of the Massachusetts Institute of Technology, having obtained his degree with high honors in the year '95. Since then he has been constantly engaged in metallurgical work, having been in the employ of a large lead and copper smelting company, for the greater part of the period, while for the last year he has held an educational appointment as Professor of Metallurgy in the University of Missouri. He gave up his position there to accept the lectureship at McGill. His attainments and experience clearly justify his selection, and it is evident that the appointment is a fortunate one for McGill, and that Dr. Porter has secured an able seconder of his efforts in the Department of Mining and Metallurgy.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain of interest to the metal trades for the month of October and the ten months ending October, 1898-99.

	Month of Oct.		Ten months ending October.	
	1898	1899.	1898.	1899.
Hardware	£1,412	£1,848	£18,842	£17,036
Cutlery	4,948	4,043	44,493	43,347
Pig iron	1,474	11,385	9,860	25,992
Bar, etc.	1,491	7,977	8,167	22,234
Railroad	—	38,979	9,119	152,881
Hoops, sheets, etc.	7,350	8,449	51,531	92,959
Galvanized sheets	10,938	8,520	54,650	57,589
Tin plates	19,578	46,925	121,015	188,585
Cast, wrought, etc., iron	2,537	10,500	22,387	50,250
Old (for re-manufacture)	—	883	3,574	5,073
Steel	3,644	40,663	43,032	110,340
Lead	3,172	7,691	31,090	41,788
Tin, unwrought	1,727	1,130	14,019	19,563
Alkali	10,339	7,891	42,048	33,196
Cement	5,825	7,894	23,518	30,537

SOME EXPERIENCES WITH PORTLAND CEMENT.*

BY W. K. ELDRIDGE, CITY ENGINEER, OF LAFAYETTE, IND.

The demand for Portland cements in all classes of work having been greater than the supply for several years past, has almost irresistibly tempted manufacturers to make premature shipments, adulterations and otherwise to issue defective goods, thereby placing an added burden and anxiety on the conscientious engineer in his endeavors to prevent the use of unseasoned and otherwise unsuitable cements, particularly in the construction of cement sidewalks. This he attempts by subjecting the cement before using to the usual tests now universally prescribed in all satisfactory specifications; but my experience of the past two seasons has indicated that the present method of conducting cement tests does not afford the engineer all the information he should obtain before an acceptance of the cement. Even if he takes the ill-spared time from his other duties to make a determination of the relative proportions of lime, silica and alumina, he would probably get no information of other possible ingredients of an injurious nature, and be left as helpless as before. Our tests as heretofore made are the usual ones for fineness, time of setting, constancy of volume and tensile strength; but it is easy to reason from a comparison of a number of results, including the action of the work after construction, that such tests may be and I believe are at times more or less deceptive and insufficient for perfect safety.

For instance, it is becoming customary for manufacturers to give artificial age to their cements by adding certain quantities of sulphate of lime. It has long been known that an excess of the sulphate is injurious to the cement, besides concealing certain actions that a test should be permitted to develop if it is to be reliable; but the temptation to go to excess in order to send out a product that will pass the usual tests without waiting for the proper age or requiring the extreme care necessary in its manufacture is evidently yielded to in many cases, our experience having fully shown that an honestly made cement not sufficiently aged will fail under the steam or boiling water test, thus betraying its immaturity, while a reinforced cement, though equally green, will pass all the tests that so far are customary. Any cement containing more hydrate of lime than is necessary for combination with the silica to form the tri-silicate of lime, runs the danger, in proportion to the excess, of the conversion of the free lime into the carbonate of lime, which action causes the cracking and seaming so common in cement walks. The boiling water test is intended to show this in a few hours, while it would require a long period of time otherwise. But since the presence of sulphate of lime will enable the cement to "boil" safely (and the greater the amount the surer it will "boil"), and further retards the action of the free lime in the work, sometimes to a late day, all value in this test is wholly lost when applied to "doctored" cements. Another inducement for the manufacturer to use sulphate of lime in dangerous quantities comes from the present demand for very finely ground, slow-setting cements; and as fine grinding hastens setting, a corrective must be applied, and if carried to excess, future disintegration is sure to occur, and the usual tests afford no warning. A demand for high initial strength is also called for in connection with slowness of setting, and those two qualities are also hostile; but since the immediate damaging effects of an excess of lime necessary to produce this high initial strength are concealed by the addition of sulphate of lime, we have a cement, finely ground, slow setting, of high tensile strength, but very dangerous to use. Having drawn a sample of a certain cement which failed under the boiling water test, I had the experiment made of ageing the cement artificially, using different proportions of sulphate of lime in regular proportions until the cement would not endure the test. No tests were made to determine whether the cement was over limed or simply too new; nor was any demonstration made of any sulphate that might have been in the cement before making our additions. When more time permits we expect to go into this part of the matter more deeply.

It was noticed that the cement required more water for gauging as the per cent. of sulphate was greater. Summarizing the results of the experiment, it shows that the time of setting is retarded quite uniformly with the progressive increase of sul-

*From a paper read before the American Society of Municipal Improvements at the Toronto meeting.

phate, and also that the capacity of resistance to the effects of the boiling water was strengthened in the same manner. So we find that in this particular case the addition of 3 per cent. sulphate of lime made the cement acceptable according to the prescribed standard of tests. If the cement then were accepted and used it may be subject to one of three causes for disintegration. If too new, or if over-limed, or if under-burnt, in either case the damaging effect of the free lime is only suspended, its time of action only retarded. If carbonate of lime had been added instead, the effects are the same, except that the disruptive elements in the cement may not show themselves for a year or more after being made, so slow is their development.

The detection of over-limed cements is often attempted by taking the increase in temperature during setting. This is a certain test provided the cement has not been "doctored," when the test fails, and the effect of the over-liming is retarded for weeks or perhaps months, but is almost sure to make the finished work unsound. In one case, where the temperature rose 23 degrees in five minutes the addition of only 2 per cent. of the sulphate so changed the action that the rise in temperature was only 1 degree in fifteen minutes. It seems then, certain that under present conditions of manufacture the rise in temperature and boiling water tests do not ensure a sound cement. Again, the tests for tensile strength show the progressive action of the sulphate of lime in imparting what may prove to be a meretricious strength to the cement, with a corresponding deception to the user.

In all the voluminous literature on cements, references to this branch of the subject are meager and unsatisfactory, some of them being positively erroneous. For instance, in a book on engineering construction by a well-known engineer of reputation, and much used as a text book, the statement is made that sulphate of lime quickens the setting time of cements. The theory that plaster of Paris, being a quick-setting material, imparts this property to what it is mixed with, seems plausible, but is denied by experiment. Why this is true seems so far to be unknown. The conclusion is also indicated that an unusually high tensile strength at an early period is a suspicious rather than a meritorious circumstance. In this connection, however, it should be remembered that almost all investigations in connection with cements have been and are being made by chemists in the employ of various cement manufacturing companies, and the information gained by each is carefully guarded by their employers as part of their stock in trade, not to be imparted to their rivals or customers. The benefits of the impartial and independent investigations of the properties of the constituents of asphalt pavements, as carried on by the city laboratories of Washington, Brooklyn and others, are well known and appreciated by the members of this society, and similar work and publications from the same sources on cement would be equally valuable. The competition among manufacturers to produce cements of high tensile strength has, I believe, deceived engineers into raising their requirements to correspond, until the danger line has been passed. One city has been raising the standard each year for a number of years, and parades this before the world as a virtue; but the manufacturer simply winks the other eye and produces a cement to correspond. The composition of cements and method of production are not now so different from ten years ago that a cement honestly and naturally made from the same rock and clay as then will now show double the tensile strength legitimately.

Authorities, what few there are, are much at variance about the amount of sulphate of lime permissible in Portland cements before injury is worked, one insisting on a limit of 1½ per cent., while another claims that 8 per cent. is allowable, with various other opinion in between, until the practicing engineer feels pretty much at sea in the matter. He is probably safe in adopting the minimum requirement, but with the risk of ruling out many good cements which overstep that limit, for it is possible that a safe amount in one cement might be injurious to another. But the worst feature is in the capacity of the sulphate to conceal bad qualities in cements totally disconnected with the sulphate itself. The question that confronts him is where shall he take his stand, and what can he do to protect himself and his work? What benefit is it for him to undertake a tedious and possibly expensive quantitative analysis of each sample, if a permissible limit cannot be decided upon, beyond which rejection shall be obligatory? It might be suggested that the minimum proportion of sulphate of lime allowed should not be so great as to prevent "blowing" under the boiling water test, if the cement be so constituted as to fail under this test. This rule would seem to place the limit at about 2 per cent., and it might well be less.

If it would be possible to decide this point, and then prescribe one or more tests that would be adequate, easily performed and inexpensive, certainly a great stride forward would be made toward insuring good work of reliable duration. But as the matter now stands, such tests as it is now customary to prescribe in specifications, fail to assure the engineer sufficient guaranty that his work will endure the test of time and the elements. The idea of a rough and ready test for sulphate and carbonate of lime has taken form out of some of our laboratory experiments, and may briefly be stated as follows:

After first trying the boiling test (for if the cement fails under this it is rejected by the terms of the specifications anyway), dissolve a portion of the sample in diluted hydro-chloric acid, when, if carbonate of lime be present, a strong effervescence of carbonic acid gas will take place; and as the carbonate should never be present in any good cement, sufficient grounds for rejection are found at once. The solution should be perfect, though it need not be absolutely clear; and if there be a residue on the bottom of the glass there is a strong suspicion of adulteration. If, however, nothing suspicious be found so far, the solution may be filtered and boiled, and a small quantity of barium chloride added, which will, if sulphate of lime be present, cause a precipitate which can be taken as a measure of the sulphate for comparative purposes. In order to have a standard for comparison let a competent chemist take a sample of cement known to be reliable and accurately determine the percentage of calcic sulphate, if any, and then add enough to bring it up to the allowable limit, say 2 per cent. Then the quantity of the precipitate under barium chloride may be preserved by sealing the beaker; and if all future tests are made with the same quantity by weight of cement in the same size of beaker, a visual comparison can be made with the prepared standard close enough for practical purposes.

(Continued on page xiv.)

WANTED—Draughtsman, thoroughly competent man. One accustomed to engine and saw mill work preferred. WATEROUS, Brantford.

WANTED—Young man familiar with installing and repairing electric recording meters. Give particulars of experience. Only hustlers and first-class penmen need apply. Advancement if satisfactory. Address "WATT," Canadian Engineer, Montreal.

FOR SALE

A good Water Power, 500 horse, situated one-half mile from railway, every facility for making siding to power. Address

J. D. THEUNISSON, Cookshire, Que.

FOR SALE

A complete, substantial and up-to-date
(Butt Weld)

TUBE MILL

At the present time **IN FULL OPERATION,** the property adjoining both railroad and canal systems, and near a large centre where labor can always be commanded. Price low, and terms easy.

For particulars address

J. C. Hodgson,
Room 11, Bell Telephone Building, Montreal, Canada

The Canadian Engineer

VOL. VII.—No. 9. TORONTO AND MONTREAL, JANUARY, 1900. $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,

E. B. BIGGAR
R. R. SAMUEL

Address—Fraser Building, Montreal, Que.

Toronto Telephone, 1392. Montreal Telephone, 2589.

UNITED STATES AGENT:

H. E. BURNETTE, Cor. Fourth and Locust Sts., Philadelphia.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Acetylene Gas Machine Patent in Court, An	247
Armstrong Planer Tool, The	253
As Others See Us	254
Catalogues, New	256
Carbide Works, Ottawa, Explosion at the Dominion	253
Canals of Canada, The	245
Cement, Beaver Portland	251
Cement, Some Experiences with Portland	255
Cyclone Grate Bar, The	250
Electric Flashes	260
Engineering, Railway	249
Fires of the Month	262
Industrial Notes	256
Literary Notes	256
Marine News	262
Mechanical Trades, Mathematics in the	241
Personal	259
Practical Man	248
Pumping Machinery	254
Rand Drill Company, New Shops of the Canadian	252
Roads, Good	251
Railway Matters	261
St. Lawrence Levels	240
Temperature	248
Water Supplies	239

WATER SUPPLIES.

W. M. WATSON.

In a former article it was intimated that the water supply of Montreal was supposed to be responsible for the high death rate of that city. As therein stated I have never examined into the details of their supply and on that ground I cannot give an opinion, but I will now try to show how a supply can become the cause of an abnormal death rate, and the risk there is in towns drawing their supply of water from drainage rivers, and while doing so I shall partly draw from the works published by Dr. John C. Thresh and Dr. Parkes, both trusted and experienced medical officers of the British Government.

Rivers flowing through very thinly populated districts may yield water to which no possible objection could be taken. Many rivers, however, are utilized as sources of a public water supply which are constantly receiving sewage from towns that are situated above the intake pipe of their own town, and on that account are liable to draw into their own supply poisonous germs ejected from diseased persons or animals.

The Rivers Pollution Commissioners appointed by the Imperial Government to thoroughly investigate such matters reported in the year 1874, that after a thorough examination they had come to the conclusion, that whether they examined the organic pollution of a river at the different points of its flow, or the rate of disappearance of the organic matter contained in the sewage that gets mixed up in fresh water and incorporated with it by some violent agitation in contact with air, or, finally, the rate at which organic matter contained in sewage is dissolved and disappears in fresh water when polluted with 5 per cent. of sewage fluids, they were in each case compelled to come to the conclusion that the oxidation of organic matters in fresh water caused by introduction of sewage proceeds with great slowness, and they found it impossible to state how far sewage must flow along with the fresh water of rivers before it becomes thoroughly oxidized and harmless.

The city of Greater London draws some of its domestic water supply from the rivers Lea and Thames at a point below where the sewage of a small town is discharged into each of them, yet we are told that the inhabitants who use the water are healthy, and this fact is used to prove that water slightly contaminated with sewage is harmless, but there is a good reason why the polluted waters of the Lea and Thames are wholesome when consumed by the people of London, viz., that after it is drawn from the rivers it flows for over twenty miles in a broad, shallow, open canal which exposes the water to the purifying influences of the air and sun and by so doing it probably secures oxidation.

The characteristics of a good domestic water supply are, freedom from color, odor, taste, turbidity and the total absence of sewage germs and other injurious substances, whether animal, vegetable or mineral. Its appearance in an open reservoir will have a bluish tint. Should a body of water show a yellow-green tint, the water cannot be good, because that color indicates the presence of vegetable or animal matters in the process of decomposition. If the tint be brown it usually proves the water is collected from peaty soils, which may be unpleasant to the eye and taste, yet is generally considered harmless. If water is of a reddish tint, it indicates the presence of iron in the water, which can be eliminated by a process of thorough aeration, which will turn the color to an opalescent appearance, that will settle out of the fluid if the water is allowed to rest quietly in a reservoir for a few days, when the water will become bright and tasteless. Any water that emits an odor when boiled should be classed as unsuitable for a town's supply. Water collected from peat land is very soft and an excellent fluid to use in steam boilers and for washing purposes, but unsuitable for the manufacturing of fine paper, or to be run through lead service pipes, because the acid extracted from the vegetation that grows on peaty soil sets up a chemical action with the lead if allowed to stand idle in the pipe for a few hours, and creates a deadly poison that is delivered at the house drawing taps, and gives the consumers the lead poison which turns their gums and teeth blue and deteriorates the blood.

It is stated in the Massachusetts health report that over 1,400 samples of drinking water were examined, taken from reservoirs, lakes, rivers, brooks, etc., and only 275 of the samples were entirely free from odors. G. N. Calkins, who makes a study of water, remarks that there are three classes of odors that have come under his notice: First,

waters that contain chemical or putrefactive decomposition; second, waters that contain odors of growth; third, water containing physical disintegration, the last two being due to odorous oils.

Thresh states that the fishy smell often found in drinking water is due to a microbe called Uroglena Americana, Professor Remson says it is due to a decomposition of a fresh water sponge, while Mr. Rafter says that it is caused by a germ named Valvax Globator.

The storage reservoir of Norwood at Plymouth, Mass., was well charged with the germ Uroglena Americana in 1892, but as long as the water remained in the reservoir and the germs were in active life, the waters did not smell, but when they were drawn into the water-mains life became extinct and they became completely disintegrated and liberated a strong smelling, oily element that was very unpleasant and unhealthy.

In a village in Essex, Eng., the water supply was poisoned by dead fish that had died in the water during the time the reservoir was frozen over, and afterward set up putrefaction; another village in the same county had the water in the watermains poisoned by a large number of small eels that were drawn into the supply pipes where they lost their life and set up decomposition. (See British Local Government report for 1887.) I lately visited the source of supply of a town that draws from the waters of the Oswegatchie River and noticed that gas rose through the volume of water from which they took their supply in many places, just as if peas were shot upward through the water causing bubbles at the surface and miniature colored circles for a second on the water where the gas burst forth. The water of this river is of a reddish color which shows the presence of iron in the water, and the gas discharged proved that there were vegetable or animal substances in a state of decomposition in the water. This class of water I should consider unfit for a public supply unless well filtered.

Rivers are natural open sewers, where the filth discharged by the inhabitants living along the land contained within the water shed is carried away to the salt water of the sea for purification; during the passage of the water towards the sea most of the solid disagreeable matters the water contains settle to the bed of the streams, occasionally making their appearance when the waters of the river are violently disturbed and the filth raked up from the bottom by wind storms. At such times the water is unsafe to use for domestic purposes and the supply should be discontinued until the river becomes calm and settled again.

A couple of weeks since I was on a diver's raft attending the laying of a water pipe into a river; the diver was down about twenty feet when a due east wind storm occurred, churning up the river water as if a number of gigantic Ferris wheel bucket pumps had been set in motion. The water quickly turned from a bright, clear fluid to a bluish black, and the diver was soon unable to see but a few inches before his glass; when the turbulent water was placed in a tumbler it exposed a great number of particles of dirt and had a slight odor. Such sudden changes in a quality of river water are common where the sewage from the inhabitants and the refuse of manufacturers are discharged into it. The waters of rivers may easily purify the dirty fluids collected from the face of the land and stagnant pools, but they cannot also provide for the purification of the sewage of the inhabitants and the foul refuse cast out by lumber mills, dyehouses, soap works, sugar refineries, chemical works and other factories. When such substances enter the river they go down the stream, the particles clinging together, seldom mixing with the fresh water of the river until the heavy solids have settled down to the bed of the river, or by some means the fresh and sewage waters are violently agitated to compel incorporation. The solids carry with them anerobic germs which breed and multiply until disturbed by storms and they receive partial oxidation by the agitation it gets during the commotion. Should such water enter the town's waterpipe the dirt would settle to the invert of the water main, especially if such water mains are larger than are necessary to supply the water takers. When once the foul solids secure lodgment in the water mains they will ferment and breed more germs, and continue to breed and increase the contamination of the water supply until the germs and dirt are well washed out; this is why efficient provision should always be made to thoroughly clean out the water pipes.

(To be continued.)

ST. LAWRENCE LEVELS.

The Chicago Drainage Canal was opened January 2nd. The water should have been let in December 1st, but legal delays made themselves felt. It was to be hoped that these delays would continue. Not that we wished to have the people of Chicago supping sewage as has been their wont these many years, nor drawing all their liquid supplies from Milwaukee, as we fear there is danger, but if the St. Lawrence is to be maintained at anything like its present level and our costly canals to be available, the people of Chicago must still continue to receive their present filthy water supply of which their own analysts constantly report "unusable." The engineers appointed by the United States Government to enquire into the probable effects of the opening of the canal state that the lake levels will be reduced by at least six inches and perhaps three feet. We have not alarmed ourselves here in Canada hitherto about this matter because we knew that what we suffered in loss of harbors and ship channels would be small in comparison with the loss of such towns as Buffalo, where each inch of deficiency in the harbor costs one million dollars for dredging, but a new danger threatens us, and we must now take measures to protect our interests, and that at once, before our all too friendly Government at Ottawa has fallen into the trap which has been set for the Canadian interest. It is contained in the report of the engineers, designated to make surveys and examinations of deep waterways and routes between the great lakes and Atlantic tide waters, which recommends the regulation of the Lake Erie level by controlling the discharge through the Niagara River by a system of fixed weirs, built near the head of the Niagara River, and a series of sluices to be operated in connection with them so as to control the discharge of the lake, and reduce the variation of its level to a small amount.

This will, of course, entail the erection of wing dams on the St. Lawrence to make Lake Ontario ports and the St. Lawrence channels navigable. It is a scheme to throw all the loss of level due to the new canal onto Lake Ontario and the St. Lawrence. The dams will make whatever level is determined upon permanent, but whatever loss is due to the diminished flow will fall on the St. Lawrence. But more serious than that, in both its first cost and its disastrous delays, would be the absolutely necessary dam and locks below Montreal at the foot of Lake St. Peter.

The Chicago drainage canal may not ruin the Canadian lake and river towns and cities, and if it does it also

destroys many great cities of the United States. But the Chicago drainage and the Niagara dam together mean the absolute ruin of Montreal as an ocean port. It will be no more an ocean port than Lachine or Valleyfield, and Buffalo will maintain its position as the chief centre of the grain carrying trade.

MATHEMATICS IN THE MECHANICAL TRADES.*

BY J. S. PLASKETT, B.A.

The subject of this paper may be considered from two standpoints. The first, and to undergraduates the most familiar point of view, is from the standpoint of the student entering or intending to enter any of the mechanical trades. A graduate of a School of Science, about to put his knowledge to the test of practical application, being a good example of this class. The second is from the standpoint of the mechanic, who, ambitious to improve his standing, determines to apply himself to those studies most likely to be of benefit to him. At the outset, however, let me disclaim any intention of touching upon the subject of technical education. I will confine myself principally to discussing the subject from the second standpoint, giving examples of the application of mathematics to the mechanical trades. Examples will also be given in which mathematical methods are justifiably superseded by mechanical ones.

The question that naturally arises in the first place is what constitutes a mechanic, or what are the mechanical trades. According to the generally accepted definition, a mechanic is "one who works with machines or implements; one skilled in shaping or uniting materials, as wood, metal, etc., into any kind of structure, or machine, or other object requiring the use of tools or instruments." The mechanical trades then would embrace those occupations at which mechanics are engaged. The ordinary use of the term seems, however, to confine the mechanical trades to those in which metal is worked, and these are what will be considered almost entirely in this paper.

The mathematical knowledge of the average apprentice or journeyman in these trades is comprised in a short and inadequate Public School training in arithmetic. They have not even touched any other branches of mathematics, while their knowledge of aritlimetic is very limited and quite insufficient to meet many of the demands that will be made upon it. Many of the operations which mechanics have to perform are done without being fully comprehended, while many others cannot be done unaided, simply from failing to understand, what would seem to even the tyro in mathematics a very simple problem.

In consequence the mechanical trades are burdened with innumerable rules and formulae, bearing on the difficulties most likely to arise, and in the hope of overcoming the lack of mathematical knowledge on the part of the operators. A very familiar instance, at least to machinists, of such rules is that relating to the cutting of screws on engine lathes. Screw cutting on a lathe depends, as no doubt most of you know, on the motion of the tool carriage at a rate definitely proportional to the revolutions of the spindle and work to be screwed.

*A paper read before the Mathematical and Physical Society of the University of Toronto, Dec. 1st, 1899.

As the carriage is moved by the revolution of a screw, called the lead screw, of a pitch which is usually 4, 6, or 8 threads to the inch, the problem resolves itself, in simple gearing, into finding two gear wheels among the set which accompanies the lathe, the numbers of whose teeth are in the ratio of the pitch required to the pitch of the lead screw. Thus, if a screw of 14 threads to the inch is required, and the lead screw is 6 threads to the inch, the gears must be in the ratio of 14 to 6. The gear on the spindle generally remains constant, say it has 36 teeth. Then on the lead screw will be required a gear of 14-6 x 36, or 84 teeth. The intermediate gear that connects the spindle and screw gears has no effect on the rate of motion, but simply serves to communicate the motion. This does not form a very intricate piece of calculation, and yet nine times out of ten you will see the machinist consulting his screw cutting tables, which, by the way, are always attached to the lathe, whenever a thread is to be cut.

If the gearing is compounded, that is if an extra pair of gears fastened to the same axle is introduced between the spindle and the screw gear, instead of the intermediate gear, the calculations are not quite so simple, although performed on the same principle, and

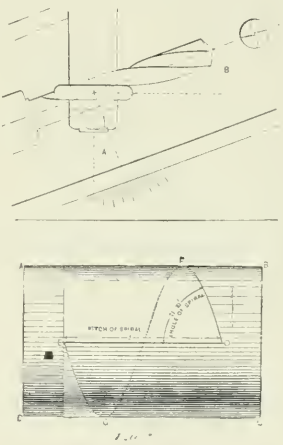


FIG. 1.

are more intricate still when spirals are required to be cut on the milling machine, a familiar example of such a spiral being the groove in a twist drill. This groove is produced by a rotating cutter somewhat similar in principle to a small circular saw, only having teeth properly shaped to produce the groove. It is evident from the upper half of Fig. 1, that the work must rotate and move longitudinally at the same time, and that these movements must bear some definite ratio to one another. When we consider the fact that the longitudinal motion is given by the rotation of a screw, that the rotary motion of the work is produced by the rotation of a worm gearing into a worm wheel to whose axis the work is fastened, and that these two rotary motions are combined (Fig. 2), by connecting the worm shaft and the screw by gears, some idea of the trickiness, I can hardly call it difficulty, of the problem dawns upon us. In addition to this, the work and the cutter must be set at an angle to one another (Fig. 1), this angle depending on the diameter of the work and the pitch of the spiral; a spiral, technically speaking, being nothing

more than a screw of great pitch, from ten to one hundred times as great as an ordinary screw of the same diameter. The first part of the calculation requires arithmetic only, but the second a slight knowledge of trigonometry. As can readily be seen from the lower half of Fig. 1, the angle that the spiral makes with the axis of the work, and consequently the angle between the cutter and the work, is the angle whose natural tangent is the ratio of the circumference of the work to the pitch of the spiral. Of course tables are given to cover most of the cases that will arise, but the utility of being able to calculate the proper gears and angle appears when a spiral is to be cut which is not on the tables. Instances like the above of the necessity of arithmetical calculations in the mechanical trades may be multiplied indefinitely, while the inability of the average mechanic to undertake them is clearly shown by

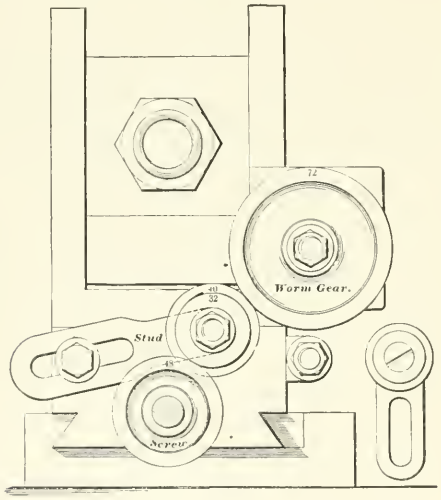


Fig. 2.

the rules, formulae and tables, which are met so frequently. I venture to say, however, that the one branch of mathematics most universally useful in all the mechanical trades is that of geometry. By geometry is not only meant the ordinary Collegiate Institute idea of the term, including practically only Euclid's elements, but also the more modern constructive and descriptive part of the subject, which is usually included in the study of mechanical drawing. Euclid, although useful, and, I think, necessary as a training for mechanics, and also as an aid in many problems likely to arise, is not so generally used practically as descriptive geometry. A knowledge of descriptive geometry and mechanical drawing will prove of very great service in every one of the mechanic arts, and is, in fact, indispensable in most of them. That mechanics should be able to read drawings is absolutely necessary. To be able to reproduce them would indicate the acquisition of a very fair knowledge of geometry, in no other way so easily attained.

To illustrate the importance of geometry in the mechanical trades seems hardly necessary, when you consider that every structure and machine is based on geometrical lines and conforms to geometrical principles. A few examples showing the application of geometry in some mechanical problems will, however, be given. How would the carpenter, if geometry were unknown, determine the forms and sizes of the various parts used in building construction? Or how would the tinsmith construct any vessels for domestic use?

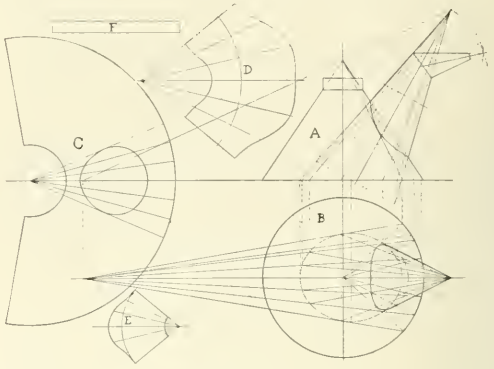


Fig. 3.

Even so simple a utensil as an ordinary tin pail would require some thought, perhaps, from our undergraduates in mathematics, in order to develop the proper form to cut the tin, that when rolled up and joined, it might be the correct shape. Again, let us consider another domestic utensil, a tin teapot. Although the tin is not beneficial to the flavor of the tea made in it, the construction of the pot itself forms a very fine problem. Figure 3, A, shows the general outline of the teapot, which I will grant is not an orthodox shape, but the peculiarities have been exaggerated for the sake of example. B. is the view from above showing the intersection of the body and spout. C. is the developed form of the body of the teapot; D. the form of the lower, E. of the upper part of the spout; F. is the band at the top, while the bottom, of course, will be a circle of the same diameter as B. The development of these forms would I fancy be rather too intricate for most of us. But you may say that tinsmiths cut the tin approximately to shape and then trim it afterwards, or that they have patterns. Well, how close an approximation would your

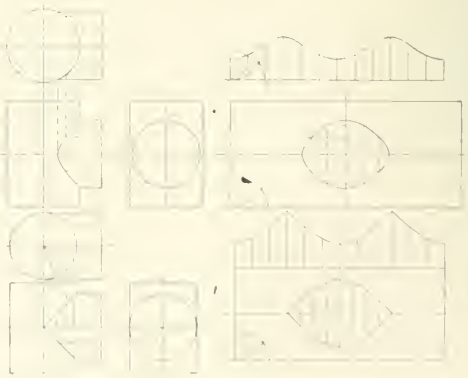


Fig. 4.

first guess of the shape of the spout be? Or how were the patterns obtained? How do boilermakers, in the construction of boilers, determine the forms to be given to the sheets, that, when rolled up, they may ex-

actly fit where two surfaces intersect, as at the junction of the dome to the main shell? The sheets are not very easily trimmed in this case. Figure 4 will illustrate the forms, the upper being the ordinary boiler and dome, and the lower the intersection of two circular cylinders of equal diameters at right angles.

In the construction of machines, work has often to be laid out, holes drilled, and other operations performed on pieces which have to come together exactly and fit perfectly, and which cannot be tried and made to suit. Geometrical methods are adapted to this purpose, and it is marvellous how accurately such work can be done. A similar example, and one perhaps more familiar to you, is in stonecutting. The stones are cut to shape and put in place, and I never remember seeing one taken down and altered. Many examples of difficult geometrical construction in stonework may be seen around the doorways and arches in University College.

From these examples it will be seen how universally geometry is employed in the mechanical trades, and how necessary a knowledge of its elementary principles at least is to all artisans. Let it not be understood, however, that it is always preferable in the practice of the mechanic arts to employ theoretical geometrical methods. Very often such is not the case, and mechanical aids are to be preferred. Who would think, for instance, of drawing a line perpendicular to another line, or of finding out if two plane surfaces were at right angles by Euclid's method, when an accurate steel square was obtainable? What would be thought of a

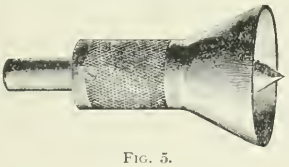


Fig. 5.
Bell Centering Punch.

machinist, who, when told to centre a circular shaft, tried to do so by bisecting the perpendicular through the middle point of any chord? As an example of mechanical methods, I will describe three ways in which this would usually be done. The bell centering punch (Fig 5), consists of a hollow cone with the punch constrained to move along the axis. This answers very well if the shafting is small and no great accuracy is required. A second method is to make a mark by a centre punch, as near the centre as possible, and then rotate the shaft between the lathe centres. It will be immediately seen when it is accurately centred by the periphery of the shaft revolving truly. If it does not run truly, the mark is punched over to the required side and again tested. As soon as the shaft runs truly, a small hole is drilled at the centre thus obtained, and this hole is countersunk by a centre reamer ground to the proper angle to fit the centres. A third and perhaps commoner method is to place the shaft in the lathe, the ordinary conical tail centre being replaced by what is called a square centre. This has the form of a square pyramid, the angle between the opposite edges being usually 60°. If the shaft is made to rotate against this square centre, while its periphery rubs against a bar firmly fixed in the tool post, it is evident that, as the sharp edges of the centre cut into the end of the shaft, they will form a conical hole. This hole will be exactly in the centre, for the outside of the shaft is constrained to move truly. The two latter methods depend of course on the geometrical property of the invariability in length of radii of the same circle.

Another problem continually arising is the division of circles, or rather the circumferences of circles, into any given number of equal parts. Euclid's method, by inscribing regular figures, is never used in practice. It

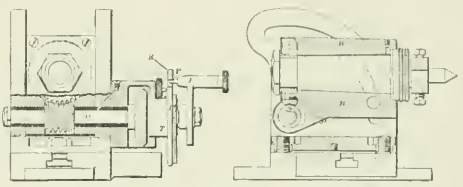


Fig. 6.

is too tedious, is only adapted for a few divisions, and is wanting in accuracy. When the division is made by hand, the circumference is always stepped off by trial with a pair of steel dividers with fine points. When the arc included by the dividers becomes so near the required one that the points cannot be moved a small enough distance by the adjusting screw, the final adjustment is made by rubbing down the proper sides of the points on an oil stone. It is by this method that large cast gears, used in mill work, three or four feet in diameter, and six inch face, have the teeth spaced off regularly, drawn to the proper form, and then chipped and filed to suit.

As in the method of centering, dividing by machine is decidedly more convenient, accurate, and expeditious. Wherever there is a milling machine, all dividing or indexing, as it is sometimes called, is performed by the index head of the machine. The head of which you see two views in the figure (Fig. 6), consists of a worm wheel, which is firmly attached to the work spindle, while gearing into this worm wheel is a worm attached to the spindle O. The worm wheel has usually 40 teeth, so that one revolution of the worm spindle, which has the crank J attached, gives 1-40th of a revolution of the work spindle, or will divide a circle attached to the work spindle into 40 parts. Suppose it is wished to divide a circle into, say, 76 parts. Then the worm

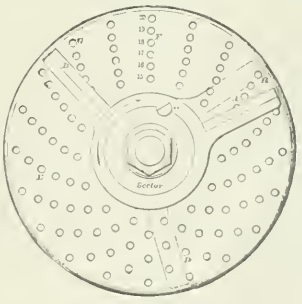


Fig 7.

must turn 40-76th's or 10-19th's of a revolution. Fastened to the side of the head (I, fig 6), concentric with the worm spindle is an index plate (fig. 7), consisting of circles of concentric equally spaced holes into

which the pin on the crank enters. To get 1-76th of a division, the pin must evidently move over 10 spaces in the 19-hole circle. By continuing to move over 10 spaces you finally divide the circle. The sectors shown are adjustable, and form a guide to the space moved over, obviating the necessity of counting at every division. Although the calculations required are not very intricate, the tables supplied are, I may safely say, always used.

This method, when the worm and wheel are accurately cut, furnishes excellent results, far excelling in speed and accuracy the ordinary stepping-off process. But if it is wished to graduate circles for astronomical purposes, as near accuracy as possible is required. The divisions are made by a worm wheel and worm, as before, but in this case, in the most approved form, the worm wheel is nearly 4 ft. in diameter, and has 4,320 teeth around the circumference, each tooth, therefore, representing a division of five minutes of arc. This wheel is in the first place divided by hand and requires the most extreme care, delicacy of touch, and microscopical exactness.

One method of dividing it, due to John Troughton, is a method of bisection. The wheel is very carefully turned and polished (no scratches) on its edge and face, and along a fine circle drawn on the face near the periphery the divisions are laid out. The radius laid out from zero gives 60°. This arc bisected and the half laid off from 60° gives 90°. The arc between 60° and

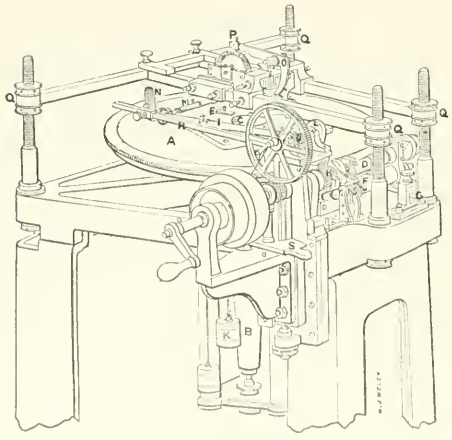


Fig. 8

Dividing Engine

90° bisected, gives 75°, and between 75° and 90° gives 82° 30′, while the arc between 82° 30′ and 90° bisected, gives 86° 15′. Further, the arc between 82° 30′ and 86° 15′, trisected, gives 85°, while the arc between 85° and 86° 15′, trisected, gives 85° 25′. Lastly, the arc between 85° and 85° 25′, quinquisected, gives 85° 20′, and this equals 5′ x 2, and so can be finally divided by continual bisection. A very fine dot, visible only to the microscope, is made at each point of division, and the errors of these dots are determined and tabulated by the aid of reading microscopes, mounted on radial arms. Finally, the teeth are cut exactly opposite the corrected positions of the dots by a cutter. Fig. 8 shows the completed machine. The plate A, is 16 inches in diameter, and has two sets of divisions, one faint on a silver inlaid ring, and the other stronger on the gun-metal. The rest of the machinery is for making the scratch and turning the plate automatically.

Another and very appropriate example of the use of mathematics arises from the cutting of the teeth on such worm wheels. Given a wheel of given diameter, with a given number of teeth, find the pitch of the worm, and the converse, given the pitch of the worm, find the diameter of the wheel for any given number of teeth. Again, given the pitch and the diameter of the worm, find the angle at which the cutter must be set in order that the teeth and worm may exactly fit. Finally, given the shape of the worm thread, determine the form of the cutter, that the wheel and worm may work smoothly and uniformly together. To solve these problems will require, besides arithmetic, a fairly thorough knowledge of geometry and elementary trigonometry, and also a knowledge of the properties of, and an ability to trace two plane curves, the involute and the epicycloid.

Such problems are continually arising in machine work, and although rules and tables can be obtained for the guidance of workmen in standard cases, other cases are very likely to arise in which original calculations will have to be made. When such is the case, how much better it is that the workman should be able to undertake the calculations himself. He then has the satisfaction that always follows a problem solved, and moreover stands a much better chance of advancement than if he were a mere machine, able only to follow rules, and depending on the guidance of tables.

It follows, from the examples that have been given, that the mathematics required in the actual performance of ordinary operations, if the calculation is to be done by the mechanic, are a thorough knowledge of, and capability of applying the principles of arithmetic, a knowledge of geometry, including descriptive geometry and mechanical drawing, and a knowledge of the elements of plane trigonometry, particularly the solution of triangles. These seem to me to be necessary to the comprehension and intelligent performance of many common operations.

I can only, in conclusion, state my belief that, although mechanics manage to perform their work tolerably satisfactorily with their present very deficient mathematical training, if even such a course of mathematics as I have outlined could be imparted to every artisan, both the quality and quantity of the work produced would be considerably enhanced, and also there would result to the workman himself a very decided advantage.

—The Engineers' Club of Toronto, at its meeting Dec. 5th, heard a very interesting paper on the Trigonometrical Survey of the Dominion, by O. J. Klotz, Astronomer to the Department of the Interior, Ottawa. The club then discussed the sewage disposal report of C. H. Rust, city engineer, Toronto, and at the close of the discussion Prof. J. Galbraith moved and E. B. Temple seconded a resolution which calls for the disposal of Toronto's sewage otherwise than in the harbor, by building intercepting sewers and by "treating the sewage by the most approved modern methods." This seems easy enough in a resolution and the Engineers' Club doubtless felt that the sanitary condition of the city was being vastly improved, but it

might be more practicable if the "most approved modern methods" were known and agreed upon. Does the Engineers' Club feel able to pronounce on this point, or does it wish to leave the matter to the experts in the Toronto city council. Perhaps it is better to wait till the Royal Commission appointed by the British Government to determine this very point has reported. A lasting benefit would be conferred on the profession, not to mention the public, if the Engineers' Club would set this matter at rest.

—Victoria, B.C., is a storm centre from an engineering point of view. We have given some notes, from time to time, on the ups and downs of its professional advisers. There is now on hand an extra fine row over the sewage system, which is planned on the separate system, and into which it has been proposed to turn the storm water.

THE CANALS OF CANADA.*

The canals of Canada is a subject that has interested the Canadian people for more than a century. The greatest of our engineers, both civil and military, have labored in their development. our politicians have found in them the cause for bitterest controversy, and our merchants have looked forward time and again to supremacy in the export trade to Great Britain and Europe after their completion; and yet to-day, the existence of many of them is unknown to most of us, and the aid they have given to the growth of our commerce but little appreciated. Their story may best be told by considering, first their history, then their construction where viewed as examples of the engineer's art, and lastly, their commercial importance. The history of the westward movement of our civilization during the present century, is, in the main, the record of the triumphs of our engineers in developing means of transportation; and the periods of greatest activity in our political life have been followed by large expenditures upon roads, railroads and canals. To-day, confident as we are that owing to the justice of our governmental system, and the fertility of our soil, our unoccupied lands present to the emigrant farmer attractions unequalled by those of any other government-held land in the world; we are still subsidizing freely every improvement in transportation facilities for the unoccupied districts, in the firm belief that our lands will not be taken up, until they are made readily accessible. It is to this long recognized principle that our canals owe their commencement.

Montreal from the days of Maisonneuve to the days of Alexander McKenzie and his associates, had but one trade—the fur-trade, and that commerce taxed to the full the transportation facilities of the country. Lachine was the western port of the city, and from it set out the trading expeditions, with their goods laden in either batteaux or canoes, that is in lumbermen's boats or in birch-bark canoes, as we know them on our rivers to-day. At the close of the 18th century they were about 30 feet long, with 6 feet beam, and could carry from three to five tons of cargo; the canoes being used on the Ottawa and Georgian Bay route, as their light weight of about 500 pounds made it possible to carry them across the numerous portages; and the batteaux were best suited to the rocky and dangerous rapids of the St. Lawrence. The profits of the trade must have been very great, for the length of time that was required to complete a transaction was appalling. Alexander Mackenzie, in his book of travels, states that it took over four years to get goods from London to trade them for furs in the Northwest, and to sell those furs in London.

It was to aid this trade that Dallier de Casson, the soldier, explorer and priest, then Superior of the Seminary of St. Sulpice, entered into contract with the engineer, Catalogne, for the construction of a cut across the divide between Lachine and little Lake St. Pierre, from which there was a canoe route to Montreal. This was in the year 1700, and although, owing to Dallier de Casson's death, the work was not completed, the gentlemen of the Seminary never ceased petitioning the King for its construction, until the old regime had passed away. The fur trade, rudely interrupted by the final struggle between France and England, was resuming its activities when the American War of Independence broke out, and after the shock of the Continental armies had broken in vain on the rock of Quebec, the soldier Governor Haldimand saw, that in order to maintain the fortified posts of the Crown in the west, built indeed largely for the benefit of the fur trade, he must have better means of forwarding supplies to them, and for that purpose he gave orders in 1779 for the building of the first St. Lawrence canal. This was built at the Cascades rapids under Capt. Twiss as engineer, and was completed in 1781; the lock being able to pass boats six feet wide, and drawing a foot and a half of water. By 1783 improvements were completed on this scale around all the rapids between Lake St. Louis and Lake St. Francis, and nothing further was done by the Government until after 1800.

But, while the Montreal traders were cheerfully paying toll to the War Department for the use of these locks, two great events of Canadian history had occurred, both in the year 1783. At that date the Northwestern Fur-Trading Company, of Montreal, began the brief, glorious and stormy life that was for awhile the life of Montreal. Its founders were men unsurpassed in our annals for vigor, courage, enterprise and ambition; their memories still linger in our streets, and are writ large upon the map of Canada; for they were the men who pushed our commercial confines to the Arctic and to the Pacific, and who, proving more than a match for John Jacob Astor and his New York associates, saved for us the Northwest. But their passions were as strong as their vigor and enterprise, and fiercely and jealously the great houses composing the company struggled against one another, and fiercely and jealously they made war upon the Hudson's Bay Company and the early Selkirk colonies, until worn out by the long struggle, the companies were at length amalgamated in 1821, and the fur trade passed away from Montreal. But in the legal records of their internal struggles Mr. Douglas Brymner found the particulars of a totally forgotten work; and a few years ago, guided by the information which he published in the Canadian Archives, engineers uncovered at Sault Ste. Marie the foundations of the first lock built by that rapid, a wooden structure, 30 feet long and 8½ feet wide, opened in 1798 by one section of the Northwest Company for the passage of their trade, and probably destroyed during the American war of 1812.

In 1783, also was signed the treaty of Versailles, perhaps the most disgraceful and cowardly action ever committed by Great Britain, when by it she abandoned the Loyalists, who had so staunchly stood for the United Empire, to persecution, confiscation and death at the hands of their enemies; but by that iniquity Canada was the gainer, and from 1784 to 1790 the Loyalists poured into her confines to build up the provinces of Ontario and New Brunswick. They had been among the ablest and most public-spirited of the citizens of the commonwealths from which they came, and from the time that they were fairly settled in Upper Canada, the cry for better access to the sea never ceased. A hundred years ago that cry could mean nothing but water-ways; a fact that is brought home to us with startling effect, when we read the speech of Adam Lymburner, a Canadian delegate sent to England to oppose the passage of the Constitution Act of 1791. That Act separated Upper and Lower Canada, and Lymburner contended that this separation was completely unnecessary as Canada never could extend beyond Hamilton, the Niagara Falls forming an insuperable obstacle.

To accommodate the rapid developing commerce of Upper Canada some improvements were made in the St. Lawrence route between 1800 and 1810, but only on the outbreak of the American War of 1812 was the insufficiency of the canals on the route fully realized by both people and Government. The building of the first Lachine canal was advised by Prevost, the Governor-General in 1815, but it was not until 1821 that the Government of Lower Canada, subsidized by the Imperial Government, undertook this work. It was completed in 1825 with stone locks 100 feet long, 20 feet wide, and 5 feet deep. While it was in progress the fur trade was passing away, and the great Quebec lumber trade was rapidly growing under the liberal fiscal policy of Great Britain towards her American colonies; its booms, dams and chutes were seen on every river; it

*From a paper by Arthur Weir, B.Sc., before the Applied Science students of McGill University.

crowded the ports of Quebec with numberless sailing vessels and built up the great fortunes of that city. The rafts of this trade passed Montreal by, but the grain trade for which our merchants and forwarders still struggle was greatly aided by the same liberal fiscal policy that extended to our grain exports that protection in the home markets that our producers now so earnestly covet.

While Lower Canada was building the Lachine canal, the Imperial Government was considering the safest means of securing water communication with Upper Canada. The works being built for purposes of defence the St. Lawrence route could not be utilized, and that by the Ottawa and Rideau rivers to Kingston was chosen. Upper Canada refused to contribute to this work on the ground that it would not furnish as suitable a commercial route as the St. Lawrence, and this refusal seems to have had the approval of the Royal Engineers, who for military reasons held that the War Department should have entire control of the canal. This view was long held and it was not until 1856 that the Home Government handed over the Rideau canal to Canada.

It was commenced by Col. By in 1826, and opened in 1832, the Carillon and Grenville canals on the Ottawa, which formed part of the route, being opened in 1834. The engineers of to-day sometimes make mistakes in their estimates, but it is questionable if their errors ever equal those made on the Rideau canal, which was commenced on an estimate of £169,000 and cost £800,000 to complete. It is but justice, however, to say that owing to the efforts of Col. By the magnitude of the work was greatly increased during construction, in order to make it suitable for steamboat traffic, which had been commenced upon the St. Lawrence by the Hon. John Molson in 1809. The Rideau route immediately became the route for heavy traffic to the west, and the attractions and the cuisine of its steamers were as energetically advertised as are those of the Empress steamers to-day. The locks were 134 x 32 x 5½, but the through route was throttled by three locks of the Grenville canal, which were built before the adoption of Col. By's report, with dimensions of 107 x 20 x 5½ and by a private lock at Vaudreuil. The Grenville locks were not rebuilt until after Confederation.

The Cascades and Cedar Rapids being within the limits of Lower Canada, the St. Lawrence route could not be opened except with the consent of that province, and it was openly charged in Upper Canada that the selfish interests of Montreal prevented this improvement. Angry at this indifference or opposition, out of sympathy with the military ends of Home Government, and urged on by that section of the province which lay below the mouth of the Rideau canal, Upper Canada was pushing on her own canal schemes. Chiefest of these was the Welland canal, built to connect Lake Erie with Lake Ontario, and to overcome Adam Lymburner's insuperable obstacle. Many claims have been made for the honor of the inception of this great enterprise, but that honor seems hardly worth striving for, for the historian Kingsford, himself an engineer, says of it, that "a wilder, more ill considered scheme than the one originally put forth, one showing more ignorance and recklessness on the part of the projectors, it is scarcely possible to conceive." Commenced in 1825 by a chartered company it was sufficiently completed by November, 1828, to let two vessels through its wooden locks of 100 x 22 x 7. But misfortune came fast, and no other chartered company perhaps has ever left such a record of intrigue, mismanagement, and disaster. Subscriptions were solicited everywhere, in Lower Canada, in New Brunswick, in New York and in England; subsidies were given by Upper Canada, by Lower Canada, and by England, and the company struggled on until the story was ended by the purchase of its works by Upper Canada in 1830. Those were troublous days in that province, and the struggle against the Family Compact was being carried on in all its intemperance and virulence, but of all the Parliamentary reports of the period none is more extraordinary than that dealing with the Welland Canal Company. It characterizes many of the proceedings of the directorate as "inexplicable; no statement has been heard which supports the justice or even expediency of arrangements which, if applied to the ordinary transactions of life, would be deemed not only ruinous but the result of insanity." And it ends, even as a Parliamentary enquiry of to day, by exonerating everybody concerned.

Upper Canada had commenced the Trent canal, and all but completed the Cornwall canal, when the great political struggle suddenly ended, and the adoption of Lord Durham's report brought about the union of the provinces in 1841. In 1840 Col. Philpotts, R.E., presented a report upon the canal navigation of the Canadas, which had been originally called for by Lord Durham. In it he recommends the St. Lawrence route as the only Canadian route that could be made to compete successfully with the Erie canal. Going into detail, he points out that the Welland canal with its badly built line and rotting locks must be reconstructed, that the Cornwall canal is unfinished and its structures rapidly deteriorating, that a new canal must be built past the Cascades and Cedars, and that the Lachine must be greatly enlarged.

Immediately after the union commenced an era of great activity in canal construction under the management of a Board of Works with H. H. Killaly as chairman, and S. Keefer as chief engineer. In these enterprises the Canadas were assured of the fullest support of the Imperial Government, both financial and military, if such were required. The recommendations of Col. Philpotts were closely followed, and by 1848, a nine foot route was open from Lake Erie to the sea. In the walls of its first completed work, the Cornwall canal remained for many years a record of changing conditions, for its locks alone of all the St. Lawrence canals were built 55 feet wide, the remainder being made 45 feet because the propeller screw had been invented and had proved more suitable for navigation than the paddle wheel. The locks of the St. Lawrence canals were built 200 x 45 x 9, and they were rapidly opened, the Cornwall in 1843, the Beauharnois in 1845 and the Lachine in 1848, and with their completion the traffic left the Rideau route forever, and it remains to-day a work of local utility, and a monument to the efforts that Great Britain put forth for the defence of Canada. In these enlargements there are two points worthy of note. The locks of the new Welland were built only 180 x 26½ feet, because the Governor-General did not think the country could bear the greater cost of the full sized locks, and the location of the Beauharnois canals gave rise to one of the bitterest political controversies of the day. It was charged that the Governor-General influenced by the Seignior of Beauharnois had caused the Board of Works to choose the present location, and that the canal ought to have been built upon the north shore of the river. The Board of Works seems, however, to have been supported by the best engineers of the day, and the controversy is only worthy of note now, because the last of the new 14 foot canals is being built upon the north shore location that was then so hotly advocated. While these works were progressing on the main route, the Chambly canal commenced by Lower Canada in the previous decade was completed, and the private lock at Vaudreuil rendered unnecessary by the opening of a Government lock at St. Annes.

The canal history of the next twenty years is one of minor developments and repairs, to accommodate a steadily increasing traffic; but with it grew a feeling that owing to the rapid increase in the size of the lake vessels, and the great activity displayed by the American railroads in concentrating the eastward traffic on the line from Buffalo to New York, that the canals must be greatly enlarged to enable our shippers to secure a share of that traffic. As more than once before, there was no practical outcome for this feeling until another great political change had come, and the Dominion was ushered in to carry on the policy instituted by Upper Canada and adopted by the United Canadas. In 1870 a commission with Hugh Allan as chairman, and S. Keefer as secretary, was appointed to consider canal enlargement. Their report of 1871 fully reviews the whole subject, and will be referred to later. They recommended enlarging the St Lawrence canal to 12 feet draught, with locks of 270 x 45, and this work was promptly undertaken by the Government, although the draught was subsequently increased to 14 feet It is not yet completed, but we may hope to see vessels drawing 14 feet of water coming down to Montreal in the latter part of 1899 or the beginning of 1900. The commission also recommended some improvements on the Ottawa river canals, which have been completed.

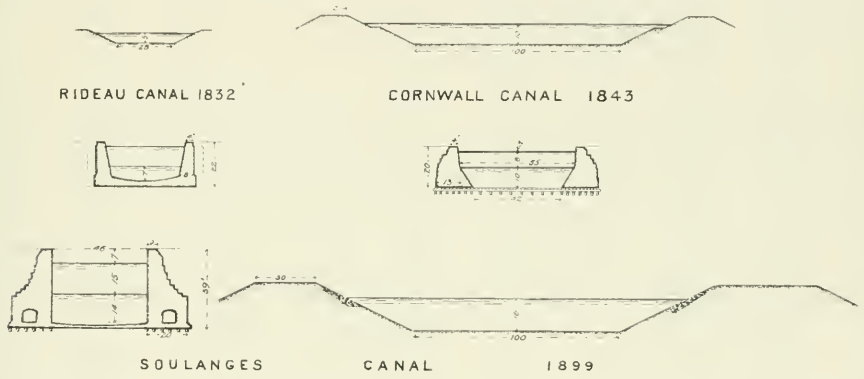
Thus at the close of the century Canada finds herself possessed of a system of inland navigation, which for extent and capacity is unequalled anywhere in the world, and of whose

construction and maintenance out of her slender resources she is justly proud. First, the St. Lawrence, extending for a total length of 71 miles, ascending a total height of 551 feet, and opening up a continuous 14 feet navigation from Montreal to Port Arthur, a distance of 1,274 miles. The locks, with one exception, are built to pass vessels 255 feet long and 44½ feet wide. The one exception is the Sault Ste. Marie lock, which is designed for the lake trade, and is 900 feet long, 60 feet wide and 20 feet deep. The separate canals in this system are, the Lachine, the Soulanges, the Cornwall, the Williamsburg, the Welland and the Sault Ste. Marie, containing in all 47 locks. Second, the Ottawa and Rideau system, from Lachine to Kingston by this route is 237 miles. The reach of it, that extends from Montreal to Ottawa, has been improved since Confederation, and by the St. Anne's, Carillon and Grenville canals passage is afforded for vessels less than 185 feet long by 44½ feet wide with 9 feet draught. Beyond Ottawa is the old Rideau canal, practically untouched since its original completion, and with no more than 4½ feet of water in some of its reaches. In all there are 55 locks and a total rise and fall to Lake Ontario of 509 feet. Third, the Richelieu, comprising the St. Ours' lock and the Chambly canal. These open up a navigation to New York, via Lake Champlain. There are 10 locks in all, overcoming a rise of 79 feet; the size of the locks is 118 feet long by 22½ feet wide by 7 feet draught. Fourth, the Trent, which has not yet been completed, and will be referred to later. Besides uninhabited and valueless, and the broad channels created made it possible to operate boats with a freedom and speed not permissible in narrow canals. The method of construction made it unique in one notable particular; no tow path could be conveniently built, and the historic canal mule never trod its banks. This method of canalization is not, however, without its faults, and there are two grave engineering objections to it. The one absolute necessity of the canal engineer is water, and that in bountiful supply, and of full depth, for on that supply and depth depends the possibility of handling boats with full cargoes in the dry fall months, and the clearest proof of the engineer's lack of foresight and ability is his failure to provide them. Too often they are naturally lacking, and a system of broad, shallow pools, which greatly increase the local evaporation, intensifies this shortage, and such a difficulty is found on the Rideau.

(To be continued).

AN ACETYLENE GAS MACHINE PATENT IN COURT.

The action arose out of the contract made between the respondent and the appellants, dated 7th July, 1897, which recited that the respondent, McMurray, applied for a patent, and was the owner and inventor of an acetylene gas machine. This contained a device for shaking the carbide. By this contract the respondent, McMurray, agreed to sell to the appellants the patent to manufacture said machine, and all improvements



these great systems, there are some minor works such as the Murray canal and the St. Peter's canal, which do not call for special mention.

Considering the canals next as works of engineering we find that two different systems of development have been used in their construction; the one being to overcome the rapids and shoals of the river by an artificial water-way dug around them, and the other to turn the river into a series of vast pools by building great dams across it. Locks are equally necessary in both systems. The Rideau and Trent navigations are constructed by the method of dams, or as it is called by the canalization of the river, while the St. Lawrence and the great part of the Ottawa and Richelieu works are canals proper.

The Rideau was and remains to-day perhaps the boldest and most extensive piece of canalization in the world, and although many of its details have now ceased to be regarded as the best engineering practice, its continued efficiency in service is a high tribute to the skill and judgment of the men who built it, especially when we consider the conditions under which they labored. It was built through an almost unexplored country, without local labor or means of sustenance, and its engineers were practically without data on which to base their designs, for there were no previously constructed works from whose failures and inconveniences they could draw their conclusions. The story of the growth of Bytown reads almost like the tales the modern newspapers tells us of Wady Halfa and the Soudan railways. It was in great measure the lack of labor that made the Royal Engineers adopt the method of dams, for by it they avoided large quantities of excavation which could at that date have been handled only at great cost; the backwater from the dams of course flooded large areas of ground, but that was and patents for said machine, that he might thereafter make in connection with the same, for the price of $3,000, payable $750 by promissory note, within ten days after the issuance of letters patent for Canada, and the assignments for same to appellants, the balance to be paid within two months after the issuance of letters patent for the United States, and the assignment thereof to the appellants. The respondent, McMurray, procured a patent for Canada, but between the date of the same and the issuance of the patent, a new shaking device was substituted for that which was in the machine, at the time of the contract, which the respondent, McMurray, claimed was an improvement on that of the former. The appellants accepted an assignment of it and paid for it. Subsequently a United States patent was applied for, and the United States Patent Office declined to patent the shaker at all, it being then old in the United States, and not the subject of a patent. The appellants thereupon declined to accept an assignment, claiming that the respondent had not fulfilled his part of the contract. The action was tried before the Hon. Mr. Justice Ferguson, whose judgment was delivered on the 20th day of September, 1898, directing judgment to be entered for the plaintiff against the defendants for the sum of $2,250, with interest from the commencement of the action, and with costs, and that the counter-claim of the defendants be dismissed with costs. The defendants appealed to the Court of Appeal for Ontario, and on the 29th day of June, 1899, got judgment, dismissing the appeal with costs. The defendants now appeal to the Supreme Court of Canada. The appellants appealed to the Supreme Court of Canada, and judgment has just been handed down, allowing the appeal with full costs. Biggar & McBrayne, Hamilton, Ont., were for the appellants, and Raymond & Cohoe, Welland, Ont., were for the respondents.

THE PRACTICAL MAN.

TABLE OF DIMENSIONS AND RESISTANCES OF PURE COPPER WIRE.*

Amer. Gauge B. & S. No.	Diameter Mils	Area. Circular Mils (d^2) 1 Mil = .001 in.	Area. Square in. ($d^2 \times .7854$).	Weight and Length, sp. gr. 8.9. Lbs. per 1000 ft.	Lbs. per Mile.	Feet per lb.	Resistance at 75° F. K Ohms per 1000 ft.	Ohms per mile.	Feet per Ohm.	Ohm per lb.
0000	460.000	211600.00	166190.	639.33	3375.7	1.56	.04906	.25903	20383.	.000076736
000	409.640	167805.00	131790.	507.01	2677.0	1.97	.06186	.32664	16165.	.00012039
00	364.800	133079.40	104520.	402.09	2123.0	2.49	.07801	.41187	12820.	.00019423
0	324.950	105592.50	82932.	319.04	1684.5	3.13	.09831	.51909	10409.	.00030772
1	289.300	83694.20	65733.	252.88	1335.2	3.95	.12404	.65490	8062.3	.00048994
2	257.630	66373.00	52130.	200.54	1058.8	4.99	.15640	.82582	6393.7	.00078045
3	229.420	52634.00	41339.	159.03	839.68	6.29	.19723	1.0414	5070.2	.0012406
4	204.310	41742.00	32784.	126.12	665.91	7.93	.24869	1.3131	4021.0	.0019721
5	181.940	33102.00	25998.	100.01	528.05	10.00	.31361	1.6558	3188.7	.0031361
6	162.020	26250.50	20617.	79.32	418.81	12.61	.39546	2.0881	2528.7	.0049868
7	144.280	20816.00	16349	62.90	332.11	15.90	.49871	2.6331	2005.2	.0079294
8	128.490	16509.00	12966.	49.88	263.37	20.05	.62881	3.3201	1590.3	.012608
9	114.430	13594.00	10284.	39.56	208.88	25.28	.79281	4.1860	1261.3	.020042
10	101.890	10381.00	8153.2	31.37	165.63	31.38	1.	5.2800	1000.0	.031380
11	90.742	8234.00	6467.0	24.88	137.37	40.20	1.2607	6.6568	793.18	.050682
12	80.808	6529.90	5128.6	19.73	104.18	50.69	1.5898	8.3940	629.02	.080585
13	71.961	5178.40	4067.1	15.65	82.632	63.91	2.0047	10.585	498.83	.12841
14	64.084	4106.80	3146.9	12.41	65.525	80.59	2.5908	13.680	385.97	.20880
15	57.068	3256.7	2557.8	9.84	51.956	101.63	3.1150	16.477	321.02	.31658
16	50.820	2582.9	2028.6	7.81	41.237	128.14	4.0191	21.221	248.81	.51501
17	45.257	2048.2	1608.6	6.19	32.683	161.59	5.0683	26.761	197.30	.81900
18	40.303	1624.3	1275.7	4.91	25.925	203.76	6.3911	33.745	156.47	1.3023
19	35.390	1252.4	983.64	3.78	20.051	264.26	8.2889	43.765	120.64	2.1904
20	31.961	1021.5	802.28	3.09	16.315	324.00	10.163	53.658	98.401	3.2926
21	28.462	810.10	636.25	2.45	12.936	408.56	12.815	67.660	78.037	5.2355
22	25.347	642.70	504.78	1.94	10.243	515.15	16.152	85.283	61.911	8.3208
23	22.571	509.45	400.12	1.54	8.1312	649.66	20.377	107.59	49.087	13.238
24	20.100	404.01	317.31	1.22	6.4416	819.21	25.695	135.67	38.918	21.050
25	17.900	320.40	251.64	.97	5.1216	1032.96	32.400	171.07	30.864	33.466
26	15.940	254.01	199.50	.77	4.0656	1302.61	40.863	215.79	24.469	35.235
27	14.195	201.50	158.26	.61	3.2208	1642.55	51.519	272.02	19.410	84.644
28	12.641	159.79	125.50	.48	2.5344	2071.22	64.966	343.02	15.393	134.56
29	11.257	126.72	99.526	.38	2.0064	2611.82	81.921	432.54	12.207	213.96
30	10.025	100.5	78.933	.30	1.5840	3293.97	103.30	545.39	9.6812	340.25
31	8.928	79.71	62.604	.24	1.2672	4152.22	127.27	671.99	7.8573	528.45
32	7.950	63.20	49.637	.19	1.0032	5236.66	164.26	867.27	6.0880	860.33
33	7.080	50.13	39.372	.15	.7920	6602.71	207.08	1093.4	4.8290	1367.3
34	6.304	39.74	31.212	.12	.6336	8328.30	261.23	1379.3	3.8281	2175.5
35	5.614	31.52	24.756	.10	.5280	10501.35	329.35	1738.9	3.0363	3458.5
36	5.000	25.000	19.635	.08	.4224	13238.83	415.24	2192.5	2.4082	5497.4
37	4.453	19.83	15.567	.06	.3168	16691.06	523.76	2765.5	1.9093	8742.1
38	3.965	15.72	12.347	.05	.2640	20854.65	660.37	3486.7	1.5143	13772.
39	3.531	12.47	9.7939	.04	.2112	26302.23	832.48	4395.5	1.2012	21896.
40	3.144	9.89	7.7676	.03	.1584	33175.04	1049.7	5542.1	.9527	34823.

* Calculated on the basis of Dr. Matthiessen's standard, viz: 1 mile of pure copper wire of 1-16-inch diameter equals 13.59 ohms at 15.5° C. or 59.9° F.

These tables are theoretically correct, but variations must be expected in practice.

TEMPERATURE.

C. A. S. E. Executive Office,
Lesson Paper No. 3.

Temperature means the sensible heat in anything, and is measured by an instrument called a thermometer. In general use we find three kinds of thermometers, Fahrenheit's, the Centigrade and Rheamur's. In Fahrenheit's the space between the freezing and the boiling points is divided into 180 spaces or degrees, the freezing point being 32°, and the boiling point being 212°. In the Centigrade the freezing is 0, and the boiling is 100°, the space between them thus being divided into 100 parts or degrees; hence its name, signifying 100 steps. In Rheamur's the freezing is 0 and the boiling is 80°, the space between being divided into 80 parts. The "0" on all these scales reads zero, all above it is plus and all below is minus, viz, a temperature of 10 below zero is written —10°.

You will clearly see by the above that 180° F. = 100° C. = 80° R., and from these we can get rules for comparing degrees of temperature on one scale to those of another. The freezing point on Fahrenheit's scale is 32° above zero, while all other thermometers have the zero at the freezing point; so that if you are given Fahrenheit, to find others from it you must first subtract 32°, but if you are given the others to find F., you should add 32° after the calculation is performed. Examples: What mark on a Centigrade will agree with 90° F.? First, 90° F. — 32° = 58° F. Then as 180° F. : 100° C. :: 58, 100 × 58 ÷ 180 = 32.2° Centigrade. Ans.

What mark on a Fahrenheit will correspond with 124° on Centigrade? The proportion would be as follows: As 100° C. : 180° F. :: 124°, 124 × 180 ÷ 100 = 223.2 + 32 = 255.2. Answer.

All measurements of whatever nature are referred to some conventional unit of its kind: The unit of temperature is one degree F. or the 180th part of the distance on the thermometric

scale, between the freezing and boiling points, under a pressure of one atmosphere.

The unit of heat, or the British thermal heat unit, is that quantity of heat necessary to be added to 1 lb. of water (at or near its freezing point), to raise its temperature 1° Fahrenheit.

The unit of power is 1 lb. lifted 12 inches, or 1 lb. of force acting through 1 foot of distance, and is called the foot pound; 33,000 foot pounds, or units of work done in one minute, make a horse-power.

The unit of work is the raising of 1 lb. through one foot, and a unit of heat is equivalent to 778 units of work.

If water is at the temperature of 60° F., how many pounds of it will it take to condense 1 lb. of steam at 5 lbs. pressure, the resultant water to be 110° F.? It is evident to answer this question you must know how much heat is in the steam. Look up the steam tables in any of your hand-books, and you will see 1151° as the heat of the steam; this we will say is $1151° = T$, and the 110° in the resultant water, is $110° = T_1$.

Then we have $\frac{1150 - T_1}{T_1 - T} = P.$, or pounds of water required.

We now have our calculation to put down in this way:

$\frac{1150 - 110}{110 - 60} = \frac{1040}{50} = 20.8$ lbs. Ans. And in this formula:

T = temperature of the water, T^1 = heat in the resultant water, S = total heat units in the steam, P = amount of T to be used. The formula before any figures are substituted for the letters would stand thus:

$P = \frac{S - T_1}{T_1 - T}$ or in figures $\frac{1150 - 110}{110 - 60} = 20.8$ lbs. water.

Many everyday problems in connection with our engines and boilers can be worked out by the simple rules of arithmetic by understanding the thermal heat unit, and its value in foot lbs. For instance: How many thermal units of heat have we in the following engine, also how much coal will be burned per hour? Diameter of cylinder, 10 inches; stroke, 24 inches; revolutions, 110; and pressure throughout the stroke, 25 lbs. First, remember the value of one thermal heat unit (T H U), and the mechanical force it will exert, viz., 778 foot lbs., then we would have to first find the foot lbs., thus: $10^2 \times .7854 \times 25 \times 2 \times 220 = 863,940$ foot lbs., and $863,940 \div 778 = 1110.46$ heat units used in the cylinder per minute. Second, if one lb. of coal contains 12,000 heat units, and our losses between the furnace and the engine piston, from escaping heat in the smoke-stack, from radiation, condensation and exhaust discharge, is 9-10 of all the heat in the coal, this leaves us but 1-10 for available work, then $12,000 \div 10 = 1200$ heat units available, and $1110.46 \div 1200 = .925$ lbs. of coal per minute; $.925 \times 60 = 55.5$ lbs. per hour, and the h.p. of the engine would be $863.940 \div 33,000 = 26.2$, which would make the coal used per h.p. per hour $55.5 \div 26.2 = 2.1$ lbs.

Latent Heat.—The latent heat of steam is that quantity of heat required to change a body in a given state to another state or form, without changing its temperature. Experiments have shown that 966.6 B T U will convert one lb. of water at 212° F. into steam of the same temperature, hence it takes 966 times as much heat to change 1 lb. of water at 212° F. to steam, as it does to raise the same weight of water from 55° to 56°. The latent heat of steam changes as the temperature under which it is generated changes. If steam is generated under a higher temperature than 212° F., the sensible heat increases, and the latent heat decreases. To find the latent heat of steam at any temperature the following rule is very nearly correct: Let T = temperature of evaporation; latent heat $= 966.6 - .7 (T - 212)$. Example: What is the latent heat of steam if the temperature is 228° F.? $966.6 - .7 (228 - 212) = 955.4$; work the brackets first, then x by .7 and subtract the result from 966.6. Water is composed of millions of molecules, which are always in motion. At 461° F. below zero we would have absolute cold and the water would be perfectly still, at 32° F. there is some movement of the particles, and as we add heat this movement increases, sending the molecules farther and farther apart, thus increasing their speed, and the greater distance between the molecules the greater the space the water will occupy, and this goes on until one cubic inch of water at 212° F. will expand until it occupies 1644 cubic inches of space, the temperature of the whole still being 212° F.; and in causing this expansion we must have added 966.6 units of heat; these have been converted into the work of driving the molecules of water further apart, and can be recovered again if we use the steam where we can apply them, for they all leave the steam as it returns to water. If we take 1 lb. of steam at 212° F. and apply it to heating our building, by the time it is all condensed back to water it has given up 966.6 heat units. In mixing steam and water let W represent the weight of steam, t_1 the temperature of the steam, and w the weight of the water, and t the temperature of the water, and T the final temperature of the mixture of steam and water, and L the latent heat of the steam, we can then formulate this rule to find the temperature of the mixture: Add together the latent heat and temperature of the steam, and multiply the sum by the weight of the steam, to this add the product of the weight and temperature of the water, and divide this sum by the weights of the steam and water; the answer will be the temperature of the mixture. This is a long rule to write down, but in formula it appears thus: $T = \frac{W (L + t_1) + w \times t}{W + w}$

If 14 lbs. of steam at 212° is discharged into 200 lbs. of water at 46°, what will be the final temperature? The weight of the steam $W = 14$ lbs., the latent heat L, is 966, the temperature of it is $t_1 = 212°$, the weight of the water is $w = 200$ lbs., and its temperature is $t = 46°$, we then have

$T = \frac{W (L + t_1) + w \times t = 14 \times (966 + 212) + 200 \times 46}{14 + 200}$. or

$966 + 212 = 1178 \times 14 = 16492$, and $200 \times 46 = 9200$, then

$9200 + 16492 = \frac{25692}{200 + 14} = \frac{25692}{214} = 120.5°$ the final temperature.

QUESTIONS.

If a Centigrade thermometer registers 120, what would be the corresponding mark upon a Fahrenheit scale?

If a Fahrenheit registers 305 what is the corresponding mark on a Centigrade?

How many heat units will be required at an engine piston if the conditions are as follows: Diameter of cylinder, 26 inches; length of stroke, 5 feet; revolutions, 60; average pressure throughout the stroke, 19½ lbs.?

A. M. WICKENS, Executive Secretary.

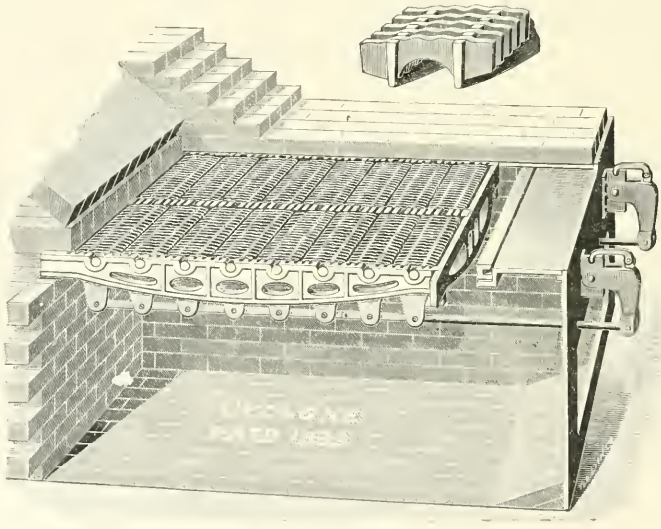
RAILWAY ENGINEERING.

The following criticism of Railway Engineering, by Cecil B. Smith, M.E., appears in a recent issue of The Railway Gazette, New York: In his introduction the author explains that this is intended as a "foundation course only," and that he has endeavored to epitomize his vast subject in such a way that a student or layman without previous knowledge can grasp it intelligently. He undertakes to cover the subject from the very beginning to the end—to tell the considerations that should govern in the general choice of the route and termini; to discuss the relations of grades and curves to future earning power and maintenance cost; to tell how all surveys are made and how roadbed, bridges, culverts and track are built; and finally to give an epitome of railroad law. He undertakes to analyze the difficult subject of train-resistance and to develop the somewhat intricate theory of easement curves. He treats of rails, their sections and chemistry, and of rail joints. All these things and much more he does in 200 pages of 500 words to the page. Obviously so much ground can be covered only superficially in a book physically so small, and the author quite truly says that the "work is not exhaustive, but merely introductory." Naturally, many things are said in a dogmatic and unqualified way that really cannot be accepted as said, without qualification. In the main, however, there is not much in the book that will seriously mislead, and generally it is safe and sound so far as it goes. It is written from the modern standpoint, indicates good theory and practice, and suggests lines of thought and study that may be profitably followed out. In this is its value, rather than as a complete and comprehensive guide to practice in any one branch of the subject treated. Biggar, Samuel & Co., publishers, Toronto and Montreal.

THE CYCLONE GRATE BAR.

There are many ways of economizing in steam production and consumption, but too much attention cannot be given to fuel economy, as the fire box is the source often of very great waste, and a loss in the initial development cannot be made up by any late method of saving. We wish to call our readers' attention to the Cyclone Grate Bar as a means of fire box economy. Presuming the majority of our readers to be interested in methods of economizing fuel, we present herewith some particulars of the Cyclone grate bar, one of the most improved devices for this purpose. In the invention and manufacture of this device, the fact has been kept in view that an enormous waste of fuel is constantly taking place by reason of the escaping of the carbonic oxides of the fuel. This is the result of imperfect combustion caused by imperfect draught, combustion chambers and bridge walls in boilers, together with imperfectly managed fires. While the inventor and manufacturers of the Cyclone grate bar do not claim it to be a smoke consumer, they do claim to reduce by from 40 to 65 per cent. the amount of carbonic oxides escaping through the chimney, which is a proof of its value as a fuel economizer.

It is claimed for this grate that it embodies the three most essential qualities, namely, durability, simplicity and economy of



fuel. An examination of the accompanying illustration will, it is believed, show these claims to be well founded. The air is passed up and through the grate without a break in the current. There are no complicated parts to obstruct the draft and get out of order, while the sifting movement alone with the downward and backward movements cuts the ash evenly and cleanly from the bottom of the fire over the entire surface of the grate.

It is not claimed for this grate that it will grind up clinkers and separate them from the unconsumed coal without losing any of the latter material, but that it is so constructed as to prevent the formation of clinkers, by adding the necessary amount of air through the grate to ensure perfect combustion, and cause the heat to pass out of the fire box as fast as it accumulates, instead of allowing it to remain and melt the coal and form a melted clinker that no grate could break. It has been found in practice that the weight of air required to support combustion is much larger than that theoretically required in order to effect complete combustion. Complete combustion can be obtained with a supply of air not less than 50 per cent. in excess of the quantity necessary for theoretical combustion with natural draft, but it is usual to provide double the quantity of air theoretically required. This grate is especially adapted to burn cheap fuel soft and hard coal, screenings, etc., and for use in marine boilers. Among the claims made for it by the manufacturers are the following:

It is claimed to be the best draft grate in the market; has no rockers and no complicated parts to get out of order underneath the bar or obstruct the draft; the rolling and lifting movement when shaken keeps the air space open and causes no friction on the draft passing through the bar; has ninety per cent. under draft; the frame locks together without bolts, and is easily placed under boiler; will not lock in frame, will not bind in frame; always shakes freely; space in ash-pit same as in ordinary bar, which is four inches; is a perfect bar for all internal fire boilers, no part is in the way to prevent the fireman cleaning out the ashes; the air is passed through and over top of frame—keeps frame cool and prevents warping; all parts of the bar and frame are trussed and bridged; will burn the cheapest fuel with the best results; will evaporate more water per pound of coal than any other device; is level at all times when locked; no bars stick up in fire and burn off; will not break boiler front when shaking. It is manufactured by the Cyclone Grate Bar Company, 10 King street west, Toronto, and is the invention of Henry Truesdell, who has spent the past fifteen years in perfecting it.

Last May, W. Cross, general master mechanic of the Canadian Pacific Railway shops at Winnipeg, Man., caused a test of the relative merits of the Cyclone and another grate to be made in his shops, and reporting thereon to Mr. Truesdell stated that the Cyclone showed up much more favorably than the other, and that the report of the inspector was also favorable, showing that the Cyclone was more easily managed and not as liable to get out of order. The test showed a saving of one ton of coal in each five hours of steaming, an increase in boiler capacity of 25.77 per cent., and an increase of revolutions of the engine 12.3 per minute. Under date of July 25, 1899, the Gurney Foundry Company wrote Mr. Truesdell as follows: "We have examined the Cyclone grate and Mr. Truesdell's ideas of same, and have so much confidence in the simplicity, durability and common sense construction, and find that it covers all the objections of the best grates now on the market, that we have arranged with Mr. Truesdell to manufacture same for our entire line of heating boilers, and have already gone to a very heavy expense in changing our grates, as we believe the advantages in using this grate in our line will more than repay us for this large outlay."

The officers of the Cyclone Grate Bar Company are: John R. Barber, Esq., M.L.A., president; George E. Challes, secretary treasurer, and Henry Truesdell, business manager.

The tannery of Sadler & Haworth, Stanbridge East, Que., has undergone this season costly and extensive alterations in the way of an addition and new machinery, thus doubling their capacity. They are now turning out three hundred and twenty-five hides per week for belting purposes.

BEAVER PORTLAND CEMENT.

BY WM. G. HARTRANFT, ASSOCIATE AM. S. OF C. E.
Designer of the Beaver Portland Cement Co.'s Works.

One of the new industries of Canada is the manufacture of Portland cement, under the Rotary Kiln system of burning, at Marlbank, Ont. The plant is owned by the Beaver Portland Cement Company, limited, with headquarters in the Canada Life Building, Montreal, Que. This company purchased on Nov. 1st, 1898, the property of the English Portland Cement Company, limited, at Marlbank, and their new plant was erected and in operation, June, 1899.

The deposit of raw materials is at the site of the works, and consists of a dry lake of about 150 acres, on which there is a deposit of marl, varying from six to thirty feet or more in depth. This marl contains from 97 to 99 per cent. of carbonate of lime, and underlying this marl is clay suitable for the making of cement, to the depth of from three to fifteen feet.. Previous to the purchase of the deposit of raw materials at Marlbank, a large number of marl deposits, situated in different parts of the Dominion, were thoroughly examined and analyzed, and were found to contain a large amount of extraneous matter, which rendered them less suitable for making a uniform quality of cement, but the deposit owned by this company is so singularly pure and free from all objectionable ingredients that a perfect and uniform quality of cement can be regularly produced therefrom.

The high grade Portland cement of to-day is essentially a tri-calcic silicate, produced by burning a mixture of finely ground lime and silica to incipient vitrification, and pulverizing the resulting clinker. The burning is accomplished in either what is known as the stationary kiln method (intermittent or continuous) or in the rotary kiln method. With the use of the stationary kiln, the raw materials are made into bricks and dried; then placed in kilns with the fuel (coke or coal). The burning is then largely out of the hands of the manufacturer, and depends on the draught and other incidents beyond his control; the result is a varying product more or less over or under burnt. If this improperly burnt material is ground with the good clinker, the result will be a cement irregular in quality. The under burnt and over burnt material varies under this process of burning from 3 to 25 per cent. of the output of a kiln, and if sorted out and discarded by the manufacturer, it is done at a considerable loss.

With the rotary kiln process of burning, the raw materials are conveyed into the kiln in powdered form, if using the dry process, or pumped in if using the wet process. The kiln is a large steel shell, six feet in diameter and sixty feet long, lined with fire brick, and erected on a slight angle. It is built to revolve at the will of the operator, through the use of a variable speed regulator, from one revolution in thirty seconds, to one in every four minutes. The raw material is fed in at one end, and the fuel, oil, or pulverized coal being applied at the other end. The amount of fuel supplied to the kiln is also regulated by a variable speed device, so that by this process, over burning or under burning of the clinker is practically unknown, as the burning is absolutely under control at all times. The operator by the use of specially prepared eye glasses, watches the burning, and if the heat in the kiln is reduced from any cause, he retards the discharge of the clinker by slowing down his kiln, and then increasing his fuel. Or, on the other hand, if the heat in the kiln becomes too intense, he increases the speed of the kiln, and reduces the fuel; either of which is accomplished by pushing a lever close at hand. Although this rotary kiln process for the manufacture of high grade Portland cement is not new in other countries, it remained for the Beaver Portland Cement Company, limited, to introduce it into Canada. This process of burning was originally patented by Ransome, of England, and was first installed about 1885 in the Gibb's Portland Cement Works on the Thames, where it was not a financial success. Mr. Jose de Navarro purchased the rights to use the process in the United States, and it was in that country that the process was improved, and brought up to the present state of perfection. The great strides made under this system of burning in the United States can be noted by the following table:

	1890 Bbls.	1893 Bbls.	1896 Bbls.	1898 Bbls.	1899 (est.) Bbls.	1900 (est.) Bbls.
Rotary Kiln.....		149,000	633,370	2,170,782	3,500,000	5,000,000
Stationary Kiln...	350,000	441,653	950,653	1,521,502	1,500,000	1,500,000
Total.....	350,000	590,653	1,543,023	3,692,284	5,000,000	6,500,000
Per cent. of total burned in Rotary Kiln.....	0	25.2	41.0	58.8	70.0	76.9

The reason of this increased use of rotary kilns is due to the engineering profession to-day requiring high grade Portland cement, uniform in quality, and to get this result, the raw materials must be uniformly hard burnt. It is also worthy of note that two of the largest and best known German manufacturers, the Alsen Portland Cement Co., and the Henmoor Portland Cement Co., are now erecting factories, in which the rotary system of burning will be used. Two rotary kilns have been in successful operation at Marlbank since June, 1899, and all the cement manufactured by the Beaver Portland Cement Company, limited, during the past season, has been distributed throughout the provinces of Ontario and Quebec, large quantities having been used in street pavements in the larger cities and towns, and also in the construction of dams, etc., where nothing but a high quality of cement was required to meet the specifications. The company has received from the various contractors and dealers, who have used the "Beaver" brand, numerous testimonials, which amply testify to its being a uniformly high grade article; all of which is amply borne out by the following tests made in various laboratories:

Aug. 4th. City of Ottawa, N. J. Ker, assistant city engineer, one inch briquettes, 7 days old.....607 lbs.
Aug. 19th. C. A. Ry., E. J. Chamberlain, gen. manager, Ottawa, one inch briquettes, 7 days old.....523 lbs.
Aug. 28th. Lathbury & Spackman's laboratory, Philadelphia, one inch briquettes, 7 days old.....795 lbs.
Oct. 12th. McGill University, Montreal, one inch briquettes, 7 days old .....705 lbs.

The company is now installing three more rotary kilns, which, in conjunction with the two kilns already in operation, will give their works a capacity in the neighborhood of 1,000 barrels per day, and will make them the largest producers of Portland cement in the Dominion of Canada. The company has no hesitation in putting its product forward as the highest grade of Portland cement manufactured, as well as the most economical for making artificial stone.

GOOD ROADS.

Upon the invitation of the York County Council, upwards of fifty gentlemen from various parts of Ontario, nearly all of them members of some municipal body, met in the York County Council chamber, Toronto, December 11th, in convention for discussion of the good roads problem. The chief feature under discussion was the assumption by counties of the construction and maintenance of certain main travelled roads in the county, the funds to be rased by a general taxation or by debentures. At the commencement of the afternoon session, W. C. Lundy, chairman of the Special Committee of the County Council, who had the matter in hand, was elected to the chair, while County Clerk Ramsden was chosen secretary. Mr. Lundy, in his opening address, after thanking the delegates for the honor conferred upon him, briefly stated the history of the road question in York county, from the toll gate days to the present, when the municipalities charged with their maintenance have failed to keep them up. At the June session of the council it had been proposed to take over some of the roads again. A committee was appointed to collect information, but so much had been received that it was felt advisable to hold a convention to discuss it.

A. F. Wood, ex-M.P.P., Madoc, Ont., then gave an address on the experience of the county of Hastings in dealing with roads. Mr. Wood sketched the history of the treatment of the roads in that county for the past forty years, beginning with the toll gate system, which was abandoned on account of the abuses which accompanied it. After several plans had been tried the county finally undertook to construct and maintain a proportion of the chief highways, constructing them of gravel. A Gravel Road Committee and a road superintendent were appointed to look after the work, employ the necessary labor

and purchase the necessary material. The result, Mr. Wood said, had been most satisfactory, and had resulted in a great saving by reason of the scientific methods of construction which experience led them to adopt. When Mr. Wood had concluded, he was besieged with questions, to which he replied fully.

J. F. Beam, Black Creek, Ont., read a spirited paper on Good Roads, Principles and Results. After referring to the failure of the statute labor system, he spoke of the example in the county of Hastings as it had been outlined by Mr. Wood. He was in full sympathy with the project of county maintenance of main roads, and expressed the strong conviction that the cities, which drew so much wealth from the county, should pay their share of the cost. He pointed out the example of a number of States where the Government gave substantial grants for the maintenance of public roads. The convention adjourned a little before five to allow the delegates to visit the new city hall.

When the evening session opened the first business was the appointment of a Committee on Resolutions, consisting of one delegate from each of the counties, represented as follows: Messrs. Harold Eagle, Haldimand; Col. McLean, Durham; J. B. Calder, Wentworth; M. Richardson, Grey; J. F. Beam, Welland; H. W. Fowlds, Northumberland; Robert Byrnes, Victoria; L. Kaufman, Oxford; W. H. Pugsley and W. C. Lundy, York; D. H. Moyer, Lincoln and F. W. Wilson, Lambton.

Andrew Pattullo, M.P.P., Woodstock, Ont., the organizer and first president of the Good Roads Association, followed. The fact that so many representatives of the people had gathered together, he said, was in itself a most hopeful sign for the success of the movement. It showed that public attention had been considerably aroused when these legislators met to seek information on the subject. The work of Mr. Campbell was appreciated at home, and now his reports were read and appreciated in other provinces and several European countries. Good roads were cheaper at any cost than bad roads. The transportation problem was the greatest one in Canada, and our duty now was to pay attention to our rural highways. He knew of no service or direction in which the councils could do so much good as to take hold of the management of the leading roads in their respective counties, and employ trained men to keep them in proper state of repair. Their example would be followed by the township councils. The present Legislature was favorable to road improvement, and he suggested that the cause could be assisted by the Government guaranteeing the bonds by which the counties borrowed money for the purpose, whereby the latter could get funds at probably a half lower rate of interest. Statute labor ought to be abolished; it was a relic of barbarism. He favored optional legislation by which municipalities could, if they wished, abolish the system. In conclusion, Mr. Pattullo suggested that the convention adjourn instead of dissolving, and that its recommendations be sent to the municipalities to be discussed in the coming elections and also at the January meetings of council, after which it would have greater effect.

John A. Ramsden gave an instructive paper on "Reforestry." As a result of the clearance of this country of its forest by the pioneers snow and dust were now free to fly over the roads, rendering travelling disagreeable both winter and summer. The planting of trees both in rows and in blocks and belts would have a very beneficial effect in protecting the roads. Mr. Ramsden recommended that the attention of the Legislature be specially drawn to this matter.

At the second day's meeting addresses were given by Hon. E. J. Davis and A. W. Campbell. A. E. Woods, of Madoc, took the chair and gave many valuable suggestions. Hon. E. J. Davis, after speaking of the early days, went on to speak on the transportation problem and the saving to farmers in good roads. Especially were they necessary for the cheese and butter industries, so that milk could be got easily to the factories. It would also help the new system of postal delivery by the farmers. On behalf of the Premier and the Government he expressed appreciation for the efforts now being made in the direction of good roads, and gave a hint that should a request be made for Legislative aid the request must be a very reasonable one to be granted.

A. W. Campbell, the Provincial road instructor, dealt with the practical side of road-making, and told the delegates what could be done if they had the money to spend in that direction. He compared the roads of Hastings with the dreadful roads of York county, and went on to show that a large amount of money expended in road-making is absolutely wasted.

The afternoon was taken up in discussing the report of the Committee on Resolutions, which went through a great sifting process before being adopted. It inculcated the following principles when finally passed: (1) The assumption of main and leading highways by county councils. (2) Provincial aid towards making and maintaining leading highways assumed by county councils in a leading road system. (3) Legislative supervision of electric railways, more especially with a view to enabling suburban railways to have access to markets or other destinations through cities or towns which have granted franchises to railroads.

These main principles will be enlarged upon by a committee appointed to prepare them for publication in pamphlet form. The Provincial Minister of Agriculture will be asked to bear the cost of printing, and the pamphlet is to be circulated among the municipal officers of the province. This committee will consist of C. E. Lundy, York; M. Richardson, Flesherton; James Graham, Lindsay; D. H. Moyer, Lincoln; W. H. Pugsley, York; M. Buchanan, Ingersoll, and the secretary, Mr. Ramsden. Among those present were: H. W. Foulds, Northumberland county; Lieut.-Col. McLean, Port Hope; B. W. Kiteley, Sharon; Thomas F. Wallace, Woodbridge; J. B. Calder, E. Kenrich, Wentworth county; M. Richardson, Grey county; Andrew Pattullo, M.P.P., Woodstock; W. J. Stark, Stouffville; R. Maitland Roy, Hamilton; W. H. Pugsley, Richmond Hill; Andrew M. Miller, East Toronto; J. L. McCullouch, East Toronto; James McDougall, Toronto; F. Beam, Welland; C. H. Gill, Toronto township; Harold Eagle, Haldimand county; R. G. Gibson, Toronto; J. C. Stokes, King; J. W. Brown, Stouffville; R. Norman, York; James Lee, Scarboro'; John A. Boad, North Gwillimbury; John Gardhouse, Etobicoke; F. W. Wilson, Petrolia; Wm. C. Grubb, Etobicoke; S. Baker, Whitchurch; J. A. Duff, Toronto; F. K. Reesor, Markham; P. G. Savage, Markham; T. H. Sylvanus, Hamilton; A. W. Campbell, provincial road instructor, Toronto; Henry Duncan, J. C. Miller, York; W. E. Switzer, Omemee; Robert Prynes, Lindsay; George Johnston, Cannington, and H. S. Cane, Newmarket.

NEW SHOPS OF THE CANADIAN RAND DRILL CO.

The extensive shops of the Canadian Rand Drill Co., Sherbrooke, Que., were opened December 9th for inspection, and from two to five o'clock there was a large attendance of citizens, who feel an interest in the progress and success of these important works. F. Lewis, president of the company; S. W. Jenckes, vice-president; A. Sangster, and others, received and showed the visitors about the premises, where nearly one hundred employees were busy at various kinds of work. After inspecting the shops and machinery the visitors were entertained with refreshments in the offices. The main shop is a brick structure, 95 feet wide by 200 feet long, well lighted from the sides and top which is filled with the latest and best patterns of wood and iron working machinery, which are to be augmented by others shortly. There are also three wings each 35 x 40 feet, the first being the office, two stories high, finished partly in wood with oak furniture, the lowest story being used for the office proper, and the upper flat for the draughting room. A fire-proof vault extends up through both stories. A second wing embraces the power house, fitted with a 90 h.p. engine, and the foundation for a large air compressor soon to be placed in position to supply the motive power for the electric crane, and the circulating pumps to supply the hot water system with which the building is heated. The third wing embraces the blacksmith shop, which will have four forges, the smoke of which will be taken by a 40-inch exhaust fan. There is also a large store house, 40 x 85 feet, west of the main shop. The C.P.R. has a siding beside the store house, and a track laid into the main shops for the purpose of handling the machinery with greater convenience. Stone foundations are laid for the heavy lathes, engines, etc. One side of the shops will be used for the compressor work and the other for pattern, drill and tool work. The heating will be done by the Eynon-Almiral system of New York.

THE ARMSTRONG PLANER TOOL.

The Armstrong planer tool is especially adapted for the economical use of self-hardening steel in planer and shaper work.

This tool is, it is stated by the makers, pronounced by all who have seen or used it to be a money-saver. It is a decided and practical extension of the Armstrong idea. The shank is drop forged of steel and is case hardened. The cutters are of self-hardening steel, rectangular in shape and of stock sizes. By means of grooved seats, into which they are placed, the cutters may be quickly adjusted to any desirable angle, and at the same time so locked into position as to render slipping impossible.

Armstrong Bros. consider rectangular shaped steel preferable to square for a planer tool cutter, as it is stiffer and at the same time admits of being ground with more side rake than square steel; cutters of rectangular shape will also admit of sharpening oftener than square without reshaping the point. The Armstrong planer tool can be used either right or left hand (see Fig. 1), and when desirable or necessary, as for instance, when cutting a keyway, it may, by simply reversing the cutter and turning the tool around, be transformed into the equivalent of a "goose neck" tool (see Fig. 2). One of these tools equipped with an assortment of properly ground cutters will, it is said, effectively equal a complete set of solid forged planer tools. Fig. 1 shows the Armstrong planer tool at work in close corners, giving a good general idea of clearance obtained. It shows also a few of the angles at which the cutter can be set. A job similar to one shown above could be finished with the planer tool, without shifting position of the work on bed. Figure 2 shows the Armstrong planer tool cutting a keyway with the cutter reversed and the tool turned around, thus throwing the cutting point behind centre of tool and practically working as a "goose-neck" tool.

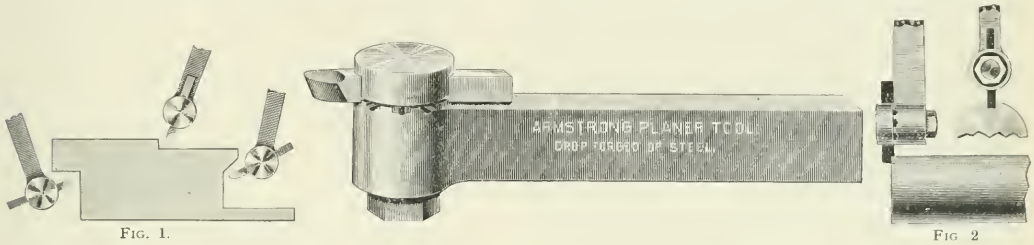


Fig. 1. Fig 2

EXPLOSION AT THE DOMINION CARBIDE WORKS, OTTAWA.

(From a Correspondent).

The official investigation into the cause of the fire and explosion at the Dominion Carbide Works, Ottawa, in Nov., has resulted in the clearing away of a great deal of ignorance and prejudice that existed on the question of calcium carbide and acetylene gas. The reports telegraphed over the country were highly colored, and contained so many misleading statements as to be utterly unreliable. Of the eighteen men hurt in the explosion, one only is permanently injured, by the loss of one of his eyes. The majority of the others were at work again in a few days after the accident. The jury selected to investigate the question was composed of hard-headed, shrewd business men. Their finding was as follows:

1. We find that there has been no evidence before us that throws any light upon the origin of the fire, which started in the story above the carbide factory.

2. As to the cause of the explosion we have attentively listened to the evidence of all the witnesses who were present at the time of the fire, as well as to the testimony of the various experts, and believe that it resulted from the joint action of steam and gas, but whether the latter was acetylene or water gas, resulting from the water coming in contact with the intensely heated material, causing decomposition of the water, the evidence is not made clear.

3. We find that the manufacture of calcium carbide is considered hazardous under certain conditions, and that in England strict regulations are enforced, both as to its manufacture and storage. It was also shown in the evidence that there is danger if it is not under strict control in its manufacture and storage. Further, that the essential conditions, which should be enforced, are a fire and water-proof building. And when these conditions are observed, no danger is likely to result in its manufacture.

4. We would recommend that the pigs after coming from the crucibles and cooling should in all instances be removed to a separate room and compartments.

5. We also find that the city by-laws, dealing with manufactures of this character, have not been observed, and would urge that hereafter the same be strictly enforced.

6. We further find that the authority of the chief of the fire brigade was not accepted by the employees of the local firms having private fire appliances, and if the city by-laws do not place the chief in absolute authority at all fires within the city limits, they should be so amended as to make his authority supreme.

The verdict was evidently a compromise between the jurymen, who paid particular attention to the evidence of men who were not experts, and those who were influenced by the scientific and practical testimony given. Such scientists as Thomas Macfarlane, Dominion Analyst, Inland Revenue Department; Prof. Shutt, Analytical Chemist, Dominion Experimental Farm, Prof. McGill, of the Geological Survey, and the practical men who handle carbide every day, testified that it was not possible to generate acetylene from red hot carbide. The evidence also proved that when the gas began to generate from the cold, broken carbide on the floor, by the water dripping down on it, it was at once fired by burning wood dropping on it from the ventilating shaft, and was consumed as fast as made, so that the explosion could not have come from that source.

All agreed that the explosion occurred within the crucible. When it is considered that the crucible contained a thousand pounds of molten carbide, covered and surmounted with an infused mixture of powdered lime and coke, between it and the iron of the crucible; that on this porous material a large quantity of water poured down from the ceiling alone, one can easily understand how rapidly the water will be developed, by contact with the molten carbide, into a very high pressure steam with an irresistible explosive force.

There is no doubt whatever in the minds of mechanics, foundrymen and other practical men, that that is precisely what occurred. The City Council, acting on the coroner's finding, has issued instructions to prepare a by law to regulate the manufacture and storage of carbide. The Dominion Carbide works are being rapidly prepared to comply with the regulations suggested by the jury. The factory is being made absolutely fire-proof, with steel girders and iron roof. It will be ready to resume operations this month, with a capacity of four to six tons per day. The Bronson factory, with a capacity of fifteen tons per day, is expected to commence smelting in February. At present such a carbide famine exists that many lighting plants have had to shut down. Once the Ottawa factories get running, there will be no more shortage.

Thos. Cantley, secretary of the Nova Scotia Steel Co., of this town, is at present in London, Eng., completing plans for the purchase of the General Mining Association coal mine at Sydney, C. B., says The New Glasgow Bulletin, recently.

AS OTHERS SEE US.

Biggar, Samuel & Co.:

Enclosed find postoffice order for $2. payment for your valuable paper, The Canadian Engineer, which pays to July, 1900. This should have been paid long ago, as the price is small considering the valuable information your paper contains.

JAS. FORDYCE,
Supt. W. W. Dept., Guelph.

Canadian Engineer:

Enclosed find my subscription for this present year. I have found great pleasure in consulting your excellent paper on all matters relating to engineering plans and designs, and especially on those articles relating to railroad building published this preceding year. Wishing your paper every success, I remain, ALEXANDER ROY, Wabigoon, Ont.

I miss The Engineer when it does not come.

J. F. MURPHY, Windsor, N.S.

In response to your post card just received, please find enclosed $1 in payment of Canadian Engineer, up to February next. I think you give good value for the amount.

JAMES B. HEGAN,
Dept. of Public Works, Charlottetown, P.E.I.

Gentlemen:—Having had space for the past twelve months in The Canadian Engineer of Toronto, it has been productive of many enquiries, and resulted in a satisfactory business for us. We can recommend it to any manufacturer desirous of introducing his goods to the Canadian trade, as without exception it stands at the very head of publications of its kind in Canada, and in fact is the only desirable medium through which to reach the machinist, supply and general hardware trade. We cheerfully speak of the satisfaction given us during the term of our subscription, and confidently recommend it to any firm desiring to reach the Canadian trade.

DIAMOND SAW & STAMPING WORKS.
Manufacturers of Hack Saws, etc., Buffalo, N.Y.

Gentlemen:—We have found very valuable information in "Practical Man" column; many of them worth much more than a year's subscription. Enclosed find $2, amount of our subscription. S. VESSOT & CO.,
Founders and Machinists, Joliette.

Enclosed is $1. The Engineer is really a gold mine of good assorted news, and most interesting and valuable. Mr. Watson's sanitary letters are grand. Your good management has made The Engineer a power in Canada, and I feel proud of it.

J. D. RONALD,
Mnfr. Fire Engines, Brussels, Ont.

PUMPING MACHINERY.*

BY C. E. MORGAN.

Perhaps the engineer in his varied experience with machinery has given but little thought to the important work that a steam pump is called upon to perform in connection with his boiler plant. I would commence by stating that although it is possible to feed a boiler with other appliances the steam pump undoubtedly is the best all round commercial article. I do not propose to enter into the question of economy of the steam pump as compared with other means of feeding boilers, such as injectors and power pumps, these no doubt have their uses as auxiliaries, and perhaps in some cases it is advantageous to use a power pump where the engine or prime mover is constantly running, as by so doing the water is pumped practically with the economy of the engine. A boiler feed pump is called upon frequently to handle water at various degrees of temperature, and this being the case certain mechanical features in its construction have to be considered. For instance, in handling water at normal temperature say 70 degrees, the ordinary inside plunger type of pump is perhaps all that is desired, whereas should the water reach a temperature of 212 degrees the conditions are different, inasmuch as the temperature of the feed water expands all working parts of the pump and it becomes necessary to have the machine so arranged that the water piston can be adjusted to meet these conditions. This feature is easily taken care of by using a special boiler feed pump, so constructed that its plungers are externally packed. This enables the engineer to immediately discern any leak which may have taken place, and to satisfy himself that the pump is fully efficient at every stroke. Some engineers have raised the objection to a certain amount of friction which is set up by the external adjustment of the plungers, but if the machine is properly made with deep well fitting neck bushes and glands, this feature is not of very much consideration, as under absolute tests the friction set up is a very small percentage.

*A paper read before C. A. S. E. No. 1, Toronto.

Difficulty is often experienced when pumps are working on very hot water, but in cases that have come under my own notice, I have usually found that the trouble has arisen by the machine being placed in a position where it would practically have to raise the water by suction, while, in place of this, it should gravitate, as the formation of a vacuum in pump would be immediately filled by the vapor from the hot water, and would consequently interfere with the proper working of the machine. It is also very important to have valves of proper materials for handling water at high temperatures. Machines are frequently condemned when really the working parts are at fault.

In steam plants it sometimes happens that in feeding boilers the pumps used are much too small for the work required. In making a choice of a steam pump for feeding boilers it is well to have it of sufficient size so that it will do its work easily. For pumps having a 4-inch stroke it is possible to run them to 150 strokes per minute; 6-inch stroke, 130; 8-inch stroke, 120; 12-inch stroke, 100; 16-inch stroke, 85, and 18-inch stroke, 80. You will note that these are maximum speeds, and for boiler feeding purposes the machines should operate at about one-fourth of the above speeds. In estimating the capacity of the boiler feed pumps the following formulae is used:

$$\frac{\text{H. P.} \times 30 \times 28}{\text{Speed in inches} \times 60} = \text{area of high cylinder.}$$

This is for a single cylinder piston pump. Of course for a duplex it would be one-half this, and for a triplex so much. In very large steam plants the compounding of boiler feed pumps is possibly a move in the right direction, resulting in a considerably more economical consumption of steam. It is very probable that a compound steam boiler feed pump will shortly be introduced, which will not be very much more expensive than the ordinary high pressure machine, and would certainly be well worth the difference in cost. We have machines of this class operating to-day, with very good results.

These compound pumps are made of either the single or duplex type; some engineers preferring the duplex machine, and others favoring the single. So far as economy is concerned, possibly the single pump is the most economical, as there are less clearance spaces to be filled, and consequently a more economical use of steam. Another feature which the single pump possesses over the duplex is that in its length of stroke it is uniform, while the duplex pump invariably short strokes on either side, which further increases waste in the use of steam. The duplex pump, however, is perfectly positive in its steam end, while the single pump has been known to give some trouble in this respect. But this is usually due to the inferior construction of the automatic valve gear. There is no good reason why a steam thrown piston valve should not be equally as positive in its operation as the positively moved one, if the ports, both steam and exhaust, are properly proportioned, and made strictly to templates. I think the field of boiler feed pumps has been pretty well covered, and I will now for a few minutes take up the condenser question. The question of economy is being studied more closely to day than was the case some few years ago and the manufacturers are asking for the most economical steam plant that can be installed. In order to achieve these results, condensing engines of different styles are being called for, and independent condensers of many types are being made to day. The horizontal single and duplex form, and the vertical single and double acting duplex or twin type, or the rotative type. The choice of any one of these condensers is regulated by the size of the plant, and for ordinary small plants possibly the horizontal single type of condenser is the cheapest. When

large units, however, have to be considered, the most efficient and economical type of air pump and condenser should be installed.

Undoubtedly the most efficient type of air-pump to-day is the single acting vertical, its high efficiency being due to the fact that all clearance spaces can be practically dispensed with, and being of the single acting type the velocity of flow is not checked by diversion. Being provided with foot and bucket valves, and these valves always covered with water, there is very little clearance space.

The lack of efficiency in the double acting horizontal or vertical type of pump is largely due to the reverse of some of the above conditions, as by the failure of the valves in closing, and also a large space between the suction and delivery valves. The speed at which air pumps can be operated depends upon the valve area which they contain. This in a great many cases, is very much contracted, and accounts for the unpleasant noise which air pumps are sometimes known to make on board steamers. If this valve area could be increased the pump would work sometimes quieter.

Beyond doubt the most economical style of air pump is the rotative vertical type, as it enables you to use steam expansively. Its first cost, however, is very much greater than the direct acting vertical type, and on account of its rotative action it is considerably more expensive to maintain. I think it is possible to construct an air pump of a design which will allow of the valve area being very largely increased, and consequently a higher speed made practicable. This experiment is at present under test, and we have every reason to believe it will prove of great commercial value.

For the practical engineer, perhaps a rule which is used for the proportion of an independent air pump and condenser for certain sized engines would be well to remember. The data which is required before being able to estimate, is the class of engine which is being used, the pressure of steam supplied the engine, point of cut off, and the number of revolutions, or piston feet travel per minute.

The formula which is used for the proportioning of independent air pumps and condensers and engines of various sizes is written thus:

$$\frac{2 \times A \times S \times C \times N \times W}{15\ F.} = \text{Area of air pump.}$$

A = Area of H. P. steam cylinder, in inches.
S = Stroke " " " " "
C = Cut-off " " " " fraction of stroke.
N = Number of revolutions of engine per minute.
W = Weight of 1 cu. ft. steam at initial steam pressure.
F = Speed of air pump in feet per minute.

I have not thought it well to occupy your time with any other class of pumping machinery but what we are familiar with, and may say that the pumps which are used for mining, pumps that are used in pulp and paper mills, and the triplex power pump, and special pumps for special purposes have not been touched upon in this paper.

SOME EXPERIENCES WITH PORTLAND CEMENT.

BY W. K. ELDRIDGE, CITY ENGINEER, OF LAFAYETTE, IND.

(Continued from last issue).

But there is another danger attending the use of Portland cements, as now made, owing to their adulteration with slag cements, or possibly ground slag itself. A great and growing industry in this country as well as in others is the manufacture of cements from blast furnace slags, going under the name of "Portland" cements. Blast furnace slag being a waste product its use for such a purpose renders possible the making of a cheaper cement, which, if as good as the regular make, should not be kept out of use. And yet, for sidewalk purposes, any engineer having experimented with this material will not consent to take any more of it in sidewalks. At the same time, it has its legitimate uses, and when submitted to the regulation tests it rarely fails to fulfill all the standard requirements, and a contractor standing squarely on his rights and dignity can compel you to let him use it. So far this season I have barred it out of sidewalks by insisting that it is not a true Portland cement, but with the expectation some day of having my ruling contested and beaten. There are some slag cement walks which appear good and durable, made of a certain brand, the manufacturer explaining that he puts the slag through a roasting process before mixing and grinding, but I fear that the engineer who accepts even this cement too trustingly would lay himself liable to a roasting also. But if there be any distinction between slag cements for sidewalk use there is certainly so far no prescribed test by which this distinction can be determined. Ground basic slags are so unstable in their composition that they have to be kept tightly corked in the laboratory to hold them from the continuous disintegration which goes on during exposure to the air. In underground work, such as street and other foundations, slag cements seem to give good results and cheapen cost, but in the case of sidewalks, a granulating and rubbing off of the surface seems to be continually going on, as in some cases now under my observation, which cannot, I believe, be attributed solely to the traffic. There are so many different constituents in slags, and so many variations in their relative proportions in different slags, that a uniform and reliable product for such extreme service as sidewalk use can hardly be expected. It is only occasionally that ores and fluxes employed in blast furnaces will produce slag suitable for cement. Also, all such slags are devoid of hydraulic properties unless a change in their composition be effected.

A common use for slag cements which our experiments are pointing to is as an adulterant for regular made Portland cement by which the cost of production may be cheapened and output increased when demands are pressing. This was first noticed in some of the German cements, from which quite an appreciable amount of finely comminuted metallic iron or steel may be extracted by a common magnet, and the same thing was more recently found in two brands of American-made cement, amounting, even by this rough-and-ready method of analysis, to about one part in one thousand. It may be that the particles of metal themselves are not injurious except to the pocket, the purchaser buying one barrel of useless metal and 999 barrels of cement; but if such a complex and mysterious substance as basic slag be present, the risk remains of some one or more of the elements affecting a structure, such as a sidewalk exposed to all the effects of heat, cold, water, frost, etc. A sample of acknowledged slag cement showed one part in about 300 of metallic iron, so that the possibility remains of a Portland cement being adulterated with about 30 per cent. of slag, and yet pass all the customary tests, and under the usual specifications would have to be accepted. A statement of the foregoing was sent to a prominent New York engineering periodical, whose editor gravely advanced the explanation that the presence of iron could be accounted for by the wear of machinery. But since many cement plants produce 1,000 barrels per day, any set of machinery that can make a daily contribution of 400 pounds of its substance to its product must, like the widow's cruse of oil, have the miraculous faculty of self-restoration between days.

A series of simple tests for slag adulteration may be carried on by anyone with slight chemical knowledge and little paraphernalia. The presence of metallic steel is a sure indication, as no such particles should be present in an honestly made cement. Shake a little of the suspected cement in a glass of water, and stir with a bar magnet of fair strength. On examination, the pole of the magnet will be found more or less covered with minute sparkling particles of steel or iron, easily distinguishable under an ordinary pocket magnifying glass, and there will also be seen minute balls or agglomerations of magnetic material of a nondescript character, which nothing but slag ever contains. If a solution of the cement with hydro-chloric acid be made, there will usually be some insoluble residue; also, a strong odor of sulphuretted hydrogen, betraying compounds of sulphur of a possible dangerous character when exposed to the air; carbonate of lime, as betrayed by effervescence, may be present or absent. The presence of phosphorus, another element of basic slag, may be ascertained by the molybdate method as laid down in the publications of the official agricultural chemists, and noting a yellow precipitation. Bulletin 46, Chem. Div. U.S. Dept. Agriculture. We have one sidewalk laid about fifteen months ago, using a German Portland cement of high reputation and corresponding price, besides sustaining a high physical test, which lasted about

ten months before showing signs of cracking, and is now in an active stage of progressive disintegration. Securing some fragments of the top course, I had the foregoing tests made for slag, and in spite of the admixture with sand which had been made in laying the walk, all the characteristic reactions were obtained except the odor of sulphuretted hydrogen, which might be accounted for by the total change of the sulphides in that length of time. On crushing the mixture and testing with the magnet, we were still able to extract bright metallic steel, though much of what was originally there had evidently been oxidized. Carbonate of lime was present in force, also the sulphate of lime, and phosphoric acid. In fact, if we had continued farther, we should doubtless have found that if there were anything in the world that ought not to be in a cement, it would be found in that cement. It has been said that the Germans waste nothing; if their slag is high in phosphorus, they make a fertilizer; that which is low in phosphorus they use in cements.

However the doctors like it, there is very little satisfaction to an engineer in holding a post-mortem, but the result of this one on the defunct sidewalk in question might be stated in this form: Dissolution caused by excess of free lime contributed by basic slag adulteration, but concealed and true prognosis prevented by the presence of calcic sulphate, complicated with ferric oxide, various sulphides, phosphorus and other undiscovered components of blast furnace slag. It is no doubt a legitimate business to engage in the manufacture of slag cements; but to use the same as an adulterant is false and fraudulent and full of danger to the user in his work.

So far, the season has been too busy to afford much time to be spent on these matters; but a collection has been made of various samples, briquettes of different ages, etc., and we hope that much information may result from more thorough and leisurely examinations that will be of much benefit to the controllers of public works, and by developing methods for practical use will supplement the present standard of tests in the direction in which this standard now fails. But it will be, I believe, of greater benefit if this investigation be undertaken by a number of laboratories, totally disconnected from any manufacturing influences, whereby one may supplement another, errors be mutually corrected, and the increase of knowledge by the competition of mind with mind be fully obtained. Until this be done, I think we may all join in the sentiment of a cement expert, who remarked that the more he learned about cements, the less he was willing to swear to.

LITERARY NOTES.

The annual calendar of McGill College and University for 1899—1900, contains some 350 pages of information about this wonderful seat of learning—the greatest in Canada.

We have Volume IV., No. 5, of the Journal of the Western Society of Engineers, containing papers, discussions, abstracts, and the proceedings of the society. Published by the society in Chicago.

The American Sewage Disposal Company, of Boston, U.S., has issued a very neat pamphlet, which contains some details as to the works it has undertaken and a full statement of the qualifications of John M. McClintock, A.M.C.E., the president and resident manager of the company.

The Slide Valve, simply explained by W. J. Tennant, A.M., M.I. M.E., revised and enlarged by J. H. Kinealy, D.E., professor of mechanical engineering in Washington University, is a cloth bound volume of 75 pages, whose profuse illustrations give a very accurate idea of this difficult mechanism.

We have received a copy of the third edition, just issued, of Gas, Gasoline and Oil Vapor Engines. This is stated to be a new book, on the subject, descriptive of their theory and power, illustrating their design, construction and operation for stationary, marine, vehicle, and motive power. This book is by Gardner D. Hiscox, M.E.

Up to date, the Canadian Engineer has received calendars for 1900 from the following companies and firms: Morton, Phillips & Co., manufacturing stationers and printers, Montreal; Royal Victoria Life Insurance Co., Montreal; National Assurance Co., of Ireland, Montreal and Toronto; the J. C. McLaren Belting Co., leather belting and mill supplies, Montreal and Toronto; Alex. Bremner, drain pipes, Portland cement, fire bricks, etc., Montreal; the Pope Manufacturing Co., bicycle manufacturers, Hartford, Conn.; Hamilton Times, Hamilton, Ont.; London Assurance Corporation, Montreal, P.Q.; Union Mutual Life Insurance Company, Toronto. These calendars are up to the former standard of excellence of the firms and companies issuing them, and we heartily thank the senders, reciprocating their good wishes for the new year.

The G. & C. Merriam Co., of Springfield, Mass., publishers of Webster's International Dictionary, now supply a need which is felt in most modern offices—that is, a dictionary, in handy form, and at a reasonable price, which gives the essence of the great International, with its definitions, synonyms, vocabularies of geographical, historical and proper names, tables of abbreviations, arbitrary signs, dictionary of mythology, etc. One of the special features of these appendixes is a very complete glossary of Scottish words and phrases, which will be generally appreciated in Canada. There is also a rhyming dictionary, and the definitions in the body of the book are elucidated by over 1,100 illustrations. The type is clear, the binding is unusually strong, and while, as its name, "Webster's Collegiate Dictionary," implies, it is specially adapted to the use of colleges and students, it is even better suited as a work for office reference. Although containing 1,016 pages, the work is not too bulky for convenient use, and we can endorse in the strongest terms the unqualified praise the new work has received from the highest educational authorities. It is published in three different bindings, cloth, sheep and half Morocco, with thumb indexes.

NEW CATALOGUES.

Interior Conduit is the name of No. 75 in the Sprague Electric Companies series of catalogues. These catalogues are, as we have said before, triumphs of the printers' art, and contain most valuable information for the electrician and the intending purchaser of electrical supplies.

The Smart-Eby Machine Co., Ltd., Hamilton, is sending out an attractive catalogue illustrating the "Webster" horizontal engine for gas, gasoline, or natural gas.

Innumerable illustrations enhance the interest of Steel Portland Cement, an artistic pamphlet sent out by the Illinois Steel Co., Chicago, to introduce its cement.

Industrial Notes.

Windsor Mills, Que., has voted $25,000 for a waterworks system.

A $10,000 Roman Catholic church will be built in Dublin, Perth county, Ont.

Meaford, Ont., voted a bonus of $56,000 to the G.T.R. and the proposed elevator.

The cheese factory at Bobcaygeon, Ont., will be changed into a butter factory.

Windsor, Que., is agitating for a waterworks system and an electric light plant.

An elevator to cost about $250,000, will be built in Quebec by the Great Northern Railway Co.

Lindsay, Ont., carried a by-law to buy the waterworks system from the company now operating it.

The Lamont Glass Works at Trenton, N.S., are to be put in operation by the Montreal Glass Co.

The sewage system in Pembroke, Ont., has been completed by the contractors, Russell & Fortin.

John Coughlan & Co., Victoria, B.C., have the contract for an hotel at New Westminster to cost $10,000.

The News-Record notes that Oelschlager Bros. are increasing their elevator building plant in Berlin, Ont.

The Cartwright, Man., Farmers' Elevator Company has been incorporated. The capital stock is $4,000.

R. B. Hanson, of Bocabec, N.B., proposes building a sawmill at the mouth of the Magaguadavic river.

Sarnia, Ont., will spend $25,000 on a trunk sewer, and $7,000 on waterworks in the present year.

St. Hyacinthe is to have a new shoe factory; the proprietors of it are A. Many, J. B. Hurteau and L. Baron.

J. Lawrence & Sons, Sarnia, Ont., have, it is said, made arrangements to erect a sawmill at Watford, Ont.

The Sutherland-Innis Cooperage Co. will build a stave, heading and hoop mill at Forest, Ont., this winter.

The Standard Chemical Company, of Toronto, is authorized to increase its capital from $80,000 to $450,000.

The Laprairie Brick Co., Montreal, has been incorporated with a capital stock of $150,000, to manufacture brick, etc.

Tottenham, Ont., has granted a loan of $15,000 to a Montreal man, who proposes to start a furniture factory there.

It is said that W. Chaplin, St. Catharines, will put up a veneer mill at Mansonville, Que., where he now has a handle factory.

A branch of the International Association of Machinists has been formed in Carleton Place, Ont., with Thos. Fraser as president.

The company proposing to make cement at Lake Medad, East Flamboro, Ont., are asking a bonus of $8,000, and speak of employing 75 hands.

The town of Durham, Ont., is asking legislative sanction for a loan of $10,000 to aid the Durham Furniture Co. in establishing a factory there.

It is said that C. H. Peters' Sons, whose tannery was recently burned at St. John, N.B., will establish their industry at Fredericton or in its suburbs.

The proposed sewage system for Bridgetown, N.S., has been postponed owing to the failure of the electors to come to an agreement. The voting resulted in a tie.

The Dodge Mnfg. Co., of Toronto, Ltd., has the contract for the shafting and hangers required for the large works of the Dominion Iron and Steel Co., Sydney, C.B.

The Acton Leather and Shoe Co., Ltd., has now completed the erection of its new tannery and factory at Actonvale, Que., and has begun operations in both places.

Arrangements are now being completed for the formation of a pork packing company in Simcoe, Ont. It will be the Simcoe Pork Packing Company, Ltd.; the proposed capital stock is $200,000.

The executive committee of the Brotherhood of Locomotive Engineers has decided to select a site in Cleveland for the permanent home of the Brotherhood. The land and building will cost $300,000.

C. Krug, W. Krug, J. Krug, C. Krug and H. Ankerman, Chesley, Ont., have been incorporated as the Chesley Rake and Novelty Co., Ltd. The capital is $20,000; chief place of business, Chesley, Ont.

Oshawa, Ont., will lend $50,000 without interest to the McLaughlin Carriage Co., in order to secure the firm's rebuilding its works, recently burned down. A three-story building, 700 x 50 feet, will be put up.

The Tracadie Lumber Company, whose mills are at Tracadie, in Gloucester county, N.B., is about to build a box factory to manufacture box shooks for the British market. The resident manager is B. H. Foster.

The works of the I. Matheson Co., New Glasgow, N.S., are being kept very busy on orders from the Dominion Iron and Steel Co., and in making up a large amount of mining machinery for the iron mines at Belle Isle, Nfld.

The Orangedale Brick and Trading Company, composed of Halifax men, are starting a large brick yard at Orangedale, C.B. They will manufacture with machinery on a large scale. Brick-making will commence in the early spring.

The municipality of St. Henri, Montreal, has decided to grant no more bonuses. This was their reply to an enquiry from the Phoenix Bridge & Iron Co., asking if a bonus would be granted in the event of the company's works being removed to St. Henri.

E. M. McDougall, Agnes H. McDougall, Jessie E. McDougall, spinsters; F. C. Henshaw, Montreal; Linda B. McDougall, Cobourg, Ont., and Robert Cowans, are being incorporated as the John McDougall Caledonian Iron Works Co., Ltd., Montreal.

T. Meyers, Bastard, Ont.; L. S. Lewis, J. N. Knowlton, Newboro, Ont., and L. H. Kerr, J. B. Pinkerton, South Crosby, Ont., have been incorporated as the Ontario Milling and Manufacturing Co., Ltd.; chief place of business, Deloraine, Man.; capital, $40,000.

Failure to pay the promised bonus of $1,000 a year has caused the courts to give the J. D. King Boot and Shoe Co. a judgment against the town of Levis, Que., and under it the J. D. King Co. has seized the property of the municipality, including fire engines, etc.

L. W. Manchie, Newmarket, Pa., and W. G. Foster, of Foster & Co., Utica, N.Y., have leased part of the Toronto Carpet Co.'s buildings on Esplanade street, Toronto, from the Atlantic Refining Co., and will make iron beds, etc., under the name of the Toronto Bedding Co.

J. A. C. Madore, M.P.; Geo. Janin, C.E.; A. Stuart, C.E.; J. B. Lapointe and I. L. Lafleur, Montreal, are being incorporated as the La Compagnie d'Assainissement et d'Utilisation des eaux d'egout, to run a sewage farm; proposed capital, $50,000; chief place of business, Montreal.

J. Penman and J. B. Henderson, Paris, Ont.; T. Littlehales, Syracuse, N.Y.; W. D. Long and H. Long, Hamilton, have been incorporated as the Penman-Littlehales Chemical Co., of Hamilton, Ltd., to manufacture chemicals from gas tar; chief place of business, Hamilton, Ont.; capital, $50,000.

An engineer by the name of Lodian claims to have determined that steel rails begin to expand after a temperature of —50° F. is reached. We would be glad to hear experiences of C.P.R engineers along the north shore, where it is cool also, if not so cool as in Siberia, where M. Lodian's observations were made.

The Ronald Fire Engine Works, Brussels, Ont., is sending out a circular, which contains some testimonials in the form of telegrams sent in answer to the enquiries of the mayor of St. John's, Que., by the fire chiefs of various towns where Ronald engines were in use. These telegrams are highly complimentary.

Canada Wood Specialty Co., Ltd., Orillia, Ont., organized by J. B. Tudhope, Wm. Tudhope, A. McPherson, J. H. Lavallee, Wm. Thomson and Geo. Thomson, is trying to secure from the town the following as a bonus: "Free light for office and factory purposes, water for drinking, 50-h.p. of electric energy, and exemption from taxation."

G. W. Grant and A. Dods, Toronto, Ont.; T. H. Hamilton, J. M. White, J. W. Gray, M.D., W. H. Hill and W. Irwin, Peterborough, Ont., have been incorporated as the Grant-Hamilton Oil Company, of Toronto, Ltd.; to manufacture and sell oils and petroleum products, varnishes, soaps and engineers' supplies; chief place of business, Toronto; capital, $40,000.

Instructions have been issued by the Customs Department at Ottawa cancelling instructions of July 1st, 1897, respecting duty on round steel in bars. The standard is advanced from 1-inch in diameter to 1½ inches, and on round steel in bars (polished) one and one-half inch in diameter and larger; the duty will be 30 per cent. ad valorem, instead of 35 per cent., as formerly.

The Dodge Mnfg. Co., of Toronto, Ltd., has enjoyed a most successful year's trade, the company's business being greater by 50 per cent. than for any previous year in its history. The Dodge Company makes a specialty of shafting, hangers and pulleys, as well as friction clutch pulleys and rope driving, and few large factories, it states, have been equipped recently which were not supplied in this line by the Dodge Co.

The United Correspondence Schools of New York city have a course of study in Mechanical Engineering especially designed to meet the needs of machinists, inventors, draughtsmen, tool-makers, machine shop laborers, pattern makers, boiler and engine builders, shop foremen, moulders and foundrymen, blacksmiths, engineers, builders and salesmen of machinery and others.

Chew Bros., Midland, Ont., have sold their sawmill property to Turner Bros., who will enlarge it. In the meantime Chew Bros. are at work upon another site in the east part of the town, where they will erect a new mill with all modern equipment. The Playfair Co. also has purchased a site, upon which it is about to erect a large timber mill. It is expected that these two mills will employ about two hundred men.—Orillia Packet.

Some years ago a local company was floated in Perth, Ont., and a bonus was secured. The Perth Courier recently published the following paragraph, which might well have been part of the obituary column: "Pending the re-opening of the Facer Car Wheel factory, the C.P.R. has taken up the switch and the rail connection, and removed the semaphore. These can be replaced when the company begins operations."

The acetylene gas plant in the Fort Steele, B.C., postoffice exploded recently, severely injuring postmaster Cann and his assistant, H. McVittie. The accident occurred through making an examination by candle light. This is an example of gross carelessness, and the accident cannot be attributed to the fact of its being acetylene gas; coal gas would explode under similar conditions.

M. J. Dodge, New York; A. R. Creelman, Q.C., and J. J. McNeil, Toronto; W. J. Sheppard, Waubashene; W. Irwin, Peterborough; A. McLeod, Bracebridge; T. H. Sheppard, G. McCormick, Orillia; J. Playfair, Midland; C. A. McCool, Ottawa, and W. D. Lummis, Spragge, Ont., have been incorporated as the Spanish River Pulp and Paper Company, Ltd., with a capital of $1,500,000.

The Laurentide Pulp Company, Ltd., has applied to the Quebec Government for an Act to amend the Act incorporating the village of Grand Mere, Que., in order to enable the officer of the said company appointed for that purpose by its board of directors, to vote in the name of the said company on all by-laws, which by-laws must be submitted to the proprietors of real estate in this village, and also to vote at the election of municipal councillors.

The Welland Press some little time ago made these sage observations about a bonus scheme: "The Hamilton iron works projectors ask a cash bonus of $25,000. Port Colborne can have them. Welland don't want them at that price; $25,000 to start other people in business is a little too thin. If they got it, they wouldn't be like other bonus-hunters if they didn't demand another $25,000 in a few years as the price for not moving away."

The Yale and Columbia Lumber Co., Ltd., which is the partial consummation of the effort to consolidate all the lumber mills of Yale and Kootenay, B.C., has been organized and includes the Genelle and Pupore mills, Nakusp, Robson and the Arrow Lakes, also the Blue mills of Rossland and Ymir, and Fisher's mills at Eholt, Phoenix and Rock Creek. The company is to be incorporated for half a million. The company has timber reserves estimated at 500,000,000 feet. Its head office will be at Greenwood, B.C.

The Gutta Percha and Rubber Manufacturing Company, of Toronto, recently finished an enormous driving belt. It was of rubber, and measured 3,520 feet in length. Its weight was nine tons. This mammoth belt was made for the grain elevator of the Intercolonial Railway at St. John, N.B., and is now in use there. Another immense main drive belt, 58 inches wide and 338 feet long, with a weight of two and one half tons, was recently completed for one of the Canadian Pacific Railway elevators at Fort William by the same company.

While British trade with Canada has largely increased, the Dominion drives a thriving commerce with the United States. The annual report of the Secretary of the United States Treasury shows Canada to rank fourth among the nations in respect of the bulk of the business done with the Republic. The total trade with the United States for the past twelve months was as follows: Great Britain, $630,260,922; Germany, $230,097,050; France, $122,742,955; Canada, $121,181,910; Netherlands, $93,763,618; Brazil $70,114,783. No other nation reached the forty million dollar mark.

Various Ontario gas companies were represented recently at a meeting in Toronto at the Walker House. The high price of materials for making gas was discussed. Within the past two years gas oil has gone up 50 per cent. in price, and the duty of 2½ per cent. is said to be prohibitive. A deputation will shortly wait upon the Dominion Government in this connection. The gas men declare it is hard to make both ends meet, which is a statement whose absurdity is so great as to cause laughter to all except those who are buyers of gas from these companies. A gas company which is not earning ten per cent. dividends is doing a poor business.

J. W. Tyrrell, C.E., Hamilton, Ont., has been chosen by the Dominion Government to explore the Keewatin district, to the east of Great Slave Lake in the Northwest Territories, as far as Chesterfield inlet. A few years ago Mr. Tyrrell explored the region north from Lake Athabasca to Chesterfield inlet, and the result of his labors was of great value to the Government. As far back as 1834 Sir George Back explored to the east end of the Great Slave lake, but stopped there on his march eastward. Mr. Tyrrell was expected to leave Edmonton about January 1, and expects to reach Fort Resolution late in March. He will be accompanied by the Rev. Archdeacon Lofthouse, of Fort Churchill. He will be away about ten months.

During the academic year 1898-99 Sir William C. McDonald has contributed to McGill University, Montreal, $7,650 to make up deficiencies in the income of the Faculty of Applied Science, and in addition to very many other generous gifts has given $30,000 to supplement the equipment of the electrical engineering laboratories; $55,000 to endow the department of mining and metallurgy, $90,000 additional endowment for the chemistry and mining building, $10,000 additional endowment for the chair of electrical engineering, $50,000 to found a chair of history associated with the name of the late Dr. William Kingsford, and has strengthened the auxiliary endowment fund, which he established in 1897, by the sum of $51,250, and a further sum of $62,500 to found and endow a "Dawson chair of geology."

Cities and towns which offer bonuses and other inducements to manufacturing concerns to locate within their borders have encouraged an evil which may recoil adversely on themselves, says the Montreal Daily Witness in a recent editorial paragraph. An instance of this sort of thing is given in the case of the Kingston Locomotive Works. It appears that the company has been offered a bonus of $75,000 to remove its plant to a town in another province, but it is said they will be content to remain in Kingston if that city will grant them the same amount. This opens a new way by which manufacturing companies may recruit their finances and gain other advantages. Any concern might manage so as to get an offer from another municipality than that in which it is situated to transfer its works for a bonus, and use the offer to compel its own town to pay a like amount under pain of removal. This is a dangerous game for municipalities to play with each other.

The announcement is made that the National Cycle and Automobile Company has decided to establish its plant in Hamilton, Ont. The company has leased temporary quarters in the old Wanzer building. James Dodge, of the Evans and Dodge Bicycle Works, Windsor, will superintend the installing of the plant in the factory. It is altogether likely that with the removal of the E. and D. bicycle works from Windsor, Ont., the Canadian Typograph Company's works, which has the same management, will also be removed there. The understanding arrived at with the company was that Hamilton men were to provide the money for the erection of the necessary factory buildings, which, with the site, were estimated to cost about $20,000. In addition to this, a bonus of $5,000 was to be raised by private subscription. In return the company agreed to provide employment for at least 300 men all the year round. The company speaks of doing a large export business.

The following were among the enquiries relating to Canadian trade received at the Canadian Government office in London recently: Walnut boards of good quality, and wooden screws, are required in considerable quantities by a London firm. The names of Canadian makers of sporting ammunition, such as .22 calibre rim fire ball cartridges used for shooting gallery purposes, and any other cartridges for small bore sporting rifle, are enquired for. Enquiry is made for firms in Canada who would supply cheap wood mantel pieces to be sent

over in a knock down condition. A large firm of manufacturers of enamelled, tinned, galvanized and japanned hollow-ware, sauce-pans, buckets, pails, etc., desire to do business with Canadian houses, and ask to be placed in communication with buyers. A Scotch firm largely interested in the export of Canadian goods, such as furniture, woodenware, hardware, provisions etc., desire to extend their business in the export of Canadian goods to British India and the Cape, and are therefore open to hear from houses who may wish for their co-operation.

Plans submitted for protection to the piers of the Ottawa and New York Railway bridge, in course of construction over the St. Lawrence River at Cornwall, Ont., have been accepted by the Department of Railways. In the old structure the bottom was solid enough to hold the weight, but owing to the depth of water and the rapid current it was deemed advisable to reinforce the substructure. According to the plans submitted it is proposed to rip-rap the pier nearest the island with heavy stone blocks of half a ton or a ton each, piling up sufficient of them to protect the concrete from ice action. To secure the pier near the Cornwall canal an annular steel caisson will be built and sunk around the present crib several feet below the bottom of the river. This will be filled with concrete, and the new and old material knit together as far as may be to form one solid mass, the whole being tied with cables embedded in concrete. The pier at the canal bank appears to have been built on soft soil, being already a couple of inches at least out of plumb, and will be taken down and rebuilt, the foundation being made perfectly secure and means taken to prevent scouring.

Personal.

J. W. Curtis, electrician for the Canada Paper Co., Windsor Mills, Que., is seriously ill.

Frank Duhamel, an engineer, and a native of New Brunswick, died in Vancouver, B.C., on November 15th, of consumption.

A. R. McVicar, Wardsville, Ont., has gone to Mexico, to superintend the construction of 100 miles of railway, for which his brother has the contract.

B. Laird, of the Robb Engineering Co., Amherst, N.S., is now in Cuba, installing some engines supplied by this company for street railway power purposes.

Maurice Bucke, mining engineer, was accidentally killed at Bear Gulch mines, near Jardine, Montana, last month. He was 31 years of age, and was a son of Dr. Bucke, of London, Ont.

William Mason, bursar and lecturer of the School of Mines, Kingston, Ont., died December 7th from acute tuberculosis. Deceased was a Scotchman, 56 years of age, and was with the British army in India.

P. L. Nasmith, who recently left the employ of the Dominion Coal Co., at Glace Bay, C.B., was presented by the employees of the company with a gold watch and chain, and Mrs. Nasmith with a silver tea service. H. Donkin, resident manager, made the presentation.

E. B. Wingate, city engineer, Hamilton, Ont., was naturalized as a Canadian citizen recently. At the time of his appointment, Mr. Wingate was a citizen of the United States.

Six miners at Sydney Mines, C.B., Z. Burchell, J. Edwards, D. Edwards, A. McDonald, R. Dixon, and N. McKenzie, fell a distance of 350 feet, and were badly crushed, a short time ago.

Francis Mill, C.E., died rather suddenly on 25th November last, aged 30 years, at the residence of his father, James Mill, J.P., Glenburnie, Maria, P.Q., from inflammation of the lungs. Mr. Mill had been in feeble health for the last four or five years. He was educated at Claremont College, Wallasey, England, and at the School of Practical Science, Toronto, and then became assistant engineer under Willis Chipman, Toronto, on the waterworks at Brockville, Ont. His friends will regret to learn of his death.

Baron Adolphe von Hugel died at the Royal Victoria Hospital, Montreal, December 20th, he having entered that institution on December 15th, suffering from an attack of paralysis. Upwards of thirty-five years ago Baron von Hugel came to Canada from Germany, and soon afterward became identified with the Midland Railway, of which he was president. At that time he lived in Port Hope, and served as Mayor of that municipality. During this time he built the Midland Railway, which eventually fell into the hands of Geo. A. Cox, and was sold by him to the Grand Trunk Railway, and became a part of that system.

James S. Taylor and Jos. Taylor, brothers of John M. Taylor, secretary-treasurer of the Dominion Radiator Co., Toronto, are now troopers in C Company, Bethune's Mounted Infantry, in South Africa. When the war broke out they were firmly established with head office in Johannesburg, and branches at Durban and Pretoria, having large mercantile interests there, holding large stocks of Canadian goods in South Africa, notably the Dominion Radiator Company, the James Morrison Brass Company, the Steel-Clad Bath Co., of Toronto, and the Pedlar Roofing Company, of Oshawa. They were jointly contractors for the Johannesburg city hospital, and in October were offered protection if they would remain and look after the hospital building in case of necessity. Later, they were ordered to leave Johannesburg.

T. H. Browne, engineer in charge of the Havana Street Railway, died last month in Cuba, of yellow fever. Captain Browne was born in Montreal in 1870. He entered the Royal Military College, Kingston, from Lincoln College, Sorel. Graduating with honors in the electrical and mechanical branches of the R.M.C., he took up a position on the construction work of the Montreal and Ottawa Railway, a year later being appointed architect for the Dominion Government in the province of Quebec, having charge of all work on Government buildings, rifle ranges, etc. Taking up his residence in Montreal, he took a commission in the Royal Scots, attaining the rank of captain, and retiring retaining rank. In 1897, he left Montreal to take a position on the staff of the Boston Street Railway, and in December, 1898, resigned that post to join the engineering staff of the Metropolitan Street Railway, New York. He resigned that place in September last to take the appointment of engineer of the new street railway in Havana, Cuba.

Walter Shanly, C.E., ex-M.P., and one of the best known engineers in America, died December 17th at the St. Lawrence Hall, Montreal, where he made his home for a great number of years. Although 82 years of age, Mr. Shanly was able to be about up to a few days ago, when he became afflicted with extreme weakness, and, although his splendid intellect was bright to the end, he kept getting weaker, until he passed peacefully away. He was the fifth son of the late James Shanly, a member of the Irish bar, who came to Canada in 1836, and settled in Middlesex County, Ont. Deceased was born at "The Abbey," Queen's County, Ireland, October 11th, 1819; was educated by private tuition, and adopted the profession of civil engineer. In his younger days he was employed by the Canadian Government on the Beauharnois and Welland canals; was engaged on railways in the United States, and later, 1851—53, was engineer of the Ottawa and Prescott Railway. Between 1851 and 1862 he was successively engineer of the Western Division of the Grand Trunk, engineer of the Ottawa and French river navigation surveys, and general manager of the Grand Trunk Railway. His most important railway work was the construction of the Hoosac Mountain tunnel, in Massachusetts, in which he was associated with his brother, the late Frank Shanly, C.E. He was widely known as a consulting engineer. He sat in the old Parliament of Canada from 1863 till Confederation, and after the union sat in the first, fifth and sixth Parliaments. He gave an unyielding support to the late Sir John Macdonald, and was the contemporary, colleague and friend of Cartier, Galt, D'Arcy McGee and other brilliant men of the time. In 1864 Mr. Shanly was a delegate to the Detroit Trade Convention, along with the late Hon. Joseph Howe, Mr. John Young, and other representative men of the British provinces. He was for some years president of the Mechanics' Bank. The funeral took place in London, Ont.

Electric Flashes.

Sarnia, Ont., is granting a 30 years' franchise to the street railway.

L. Smith, Blenheim, Ont., proposes to put in an electric light plant at Little Current, Ont.

In Pembroke, Ont., a by-law for the purchase of the electric light plant was carried by over 200 majority.

The corporation of Picton, Ont., has awarded its meter and supply orders to the Canadian General Electric Co.

W. H. Meldrum purchased the entire plant of the Paris Electric Light Co., and took possession on Dec. 12.

H. Corby, distiller, Belleville, Ont., has placed an order with the Royal Electric Co. for a 100-light direct current generator.

In Woodstock, Ont., a by-law was voted on, January 1st, for the purchase of the electric lighting plant, which was carried. All night lighting was decided on.

The Cataract Power Company, Hamilton, Ont., is building a brick addition to the transformer station at Victoria avenue, Hamilton, which will cost $8,000.

Gilmour & Co., Trenton, Ont., has lately installed in their mills a 100-light D.C. generator from the Royal Electric Co.

The Cataract Power Co., Hamilton, Ont., will provide free electric lighting to the township of Barton in return for a right of way.

The McCarthy Brewing Co., of Prescott, Ont., is installing a lighting system in its brewery at Prescott, using the Canadian General Electric Co.'s apparatus.

The Granby Consolidated Mining and Smelting Co., Grand Forks, B.C., has installed a 50-light direct current generator of the Royal Electric Co.'s manufacture.

The Ogilvie Milling Co., of Winnipeg, Man., has bought from the Canadian General Electric Co. a 30-k.w. direct current generator of its standard multipolar type.

The Drayton, Ont., Electric Light Co. is refitting its station equipment, and has placed an order for a 30-k.w. "S.K.C." twophase machine with the Royal Electric Co., Montreal.

The Dominion Iron and Steel Co., Sydney, C.B., has added another 40-h.p. 250 volt motor to the order already given for electric plant. The Canadian General Electric Co., has the entire contract.

The American Alkali Co., of Sault Ste. Marie, has placed an order for the switchboard necessary for its electrolytic plant, with the Canadian General Electric Co., which company is supplying the generator.

The Faculty of Applied Science, McGill University, Montreal, has received from a United States citizen, resident in New York, $10,000, to found a research scholarship at McGill in electrical engineering.

The Toronto Carpet Co. has increased its order for electric plant, and is now installing a 55-k.w. generator in place of the 30-k.w. originally ordered. The Canadian General Electric Co. has the work in hand.

Bothwell, Ont., is increasing its plant by the installation of two 20 k.w. generators to replace those originally purchased. The order, as in the first case, has been placed with the Canadian General Electric Co.

F. J. Davidson, Windsor, N.S., and H. McC. Hart, Halifax, N.S., are interested in the proposed calcium carbide works at Windsor, N.S., for which local capital, amounting to $100,000, has been subscribed.

According to the report of the Inspector of Weights and Measures for the year ending June 30th, 1899, there were doing business in Canada, 276 companies or individuals, supplying electric light, having a total of 630,732 lamps.

The Dodge Mnfg. Co., of Toronto, Ltd., has just installed a complete jack shaft equipment, consisting of floor stands, heavy shafting, iron pulleys, friction clutch pulleys, belt tightener, etc., in the new municipal electric plant of the city of Winnipeg.

The Kingsville, Ont., Electric Light Co. is increasing the capacity of its incandescent plant by the addition of a 75-k.w. alternator, the order for which has been placed with the Royal Electric Co.

The Manhattan General Construction Co., Newark, N.J., has sold, through its Toronto office, a 35-lamp alternating current series arc lighting plant, including regulator, to the corporation of Campbellford, Ont.

J. M. Deagle, of Cataract, Ont., has ordered a complete electric light plant for the town of Erin, Ont., with the Royal Electric Co. The order includes a 30-k.w. alternator, and 300 light capacity in transformers.

The St. Francois Xavier College, Antigonish, N. S., has placed an order with the Canadian General Electric Co. for a storage battery plant, consisting of a fifty-five cell battery, and one M.P.-4-17½-k.w. direct current generator.

A large number of motors taken in exchange are advertised for sale by the Jones & Moore Co., under the heading of Electric Bargains. Many of those offer exceptional values, as they are of standard voltages and makers, and have been but slightly used.

The Toronto Rubber Shoe Mnfg. Co. has purchased a 35-lamp alternating current series arc lighting plant, including regulator, for its factory, and the street illumination in Port Dalhousie. The Manhattan General Construction Co. is furnishing the equipment.

The Toronto Rubber Shoe Co., of Port Dalhousie, Ont., is installing in its new factory a 150-k.w. "S.K.C." twophase generator with switchboard, and one 30-h.p., and one 7-h.p. "S.K.C." twophase induction motors. The entire factory will be lighted and operated by electricity.

The St. Thomas Gas and Electric Co. is increasing its lighting capacity, and in doing so has decided to change its lighting system from singlephase to twophase, having ordered from the Royal Electric Co. a 150-k.w. "S.K.C." twophase machine with marble switchboard and instruments.

The Toronto and Hamilton Electric Co., Hamilton, Ont., is now in its new shop, a two-story building, 60 x 100 feet, in which some new machinery is being installed to meet the requirements of the increasing business of the company. All the machinery in the works is electrically driven.

The Pittsburg Reduction Company has awarded a contract to the Westinghouse Electric and Manufacturing Company for 11 electric generators, to cost $150,000, for installation in the great new aluminum works it will erect early next spring at Shawenegan Falls, on the St. Maurice River, Quebec.

The Coaticook Electric Light and Power Co. is increasing its lighting plant by the installation of another 2,000-light alternator with switchboard. It is also catering for electric power, for which purpose it has bought a 100-k.w. 550 volt direct current generator with switchboard complete. Both the above machines are of the Canadian General Electric Co.'s standard make.

The Dominion Electric Heating and Supply Co., Ottawa, has been out of business for the past year, owing to a dispute between the inventor of the process and the directors of the company. The creditors have received nothing, but efforts are being made to sell the second process of the company, and if this is done a dividend may be paid.

The St. Thomas Gas and Electric Co. is making changes and additions to its plant to meet increasing demands. For arc lighting purposes it is installing a Brush arc dynamo, with capacity for 125 lamps, manufactured by the Canadian General Electric Co. This company has also been operating the St. Thomas Street Railway for some time past from its power house, using two 100 k.w. generators of the General Electric standard type.

Greenwood, B.C., is putting in a lighting plant. G. C. Hinton & Co., Vancouver and Victoria, B.C., have the contract which calls for one 150-k.w. 2,000 volt, twophase "S.K.C." inductor type generator of 3,000 light capacity, complete with all equipments; and all material, insulators and supplies, the generator, switchboard, etc., being of the very latest and most approved pattern. The plant will cost in the neighborhood of $20,000.

As the result of a conference between Dr. Hoepfner, of the Hoepfner Refining Company, Hamilton, Ont.; John Patterson, of the Cataract Power Company, and an expert from the Krupp Gun Works, in Germany, it has been decided to enlarge the refinery premises in Hamilton by four times its present dimensions. The plant as it now stands consists of a main building, 236 x 55 feet, and three smaller buildings, and as soon as these are in operation the enlargement will be started, and the works when completed will cover six acres of land.

The Orangeville Electric Light and Power Co. is improving and extending its plant to meet a constantly increasing business, and a demand for an improved and economical street lighting circuit. For its incandescent requirement it has ordered another standard 60-k.w. alternator, with a complete new marble panel board for both machines. For the street lighting the present open arc direct current plant will be abandoned and in place will be installed a constant current alternating system. This will consist of a 50-light series transformer with switchboard for same, together with 30 improved constant current lamps for operation from the same. This company has recently discarded the old 52 volt switchboard transformer system, substituting therefor large size type "H" transformers, feeding into a complete system of 3-wire secondary mains designed in accordance with modern practice. The single phase system will be adhered to. The Canadian General Electric Co. has the contract.

The Montreal Cotton Co., Valleyfield, Que., is pushing the extension to its new power house, and expect that by May 1st next, it will be completed, and the new 1,200-k.w. generator in operation. An interesting feature of this installation, which will be the largest industrial electric plant in the world, will be the switchboard arrangement. This will consist of a series of blue vermouth marble panels, 36 inches wide by 88 inches high, upon which will be mounted the necessary switches for controlling the motor circuits, and all instruments for controlling the generators and exciters. There will be used for present equipment twelve feeder panels and six generator panels. The entire board, as covered by present orders, will be 54 feet long, and when completed will present an imposing appearance, and will meet all requirements necessitated by the peculiar condition under which this plant operates, and the entire work will no doubt reflect credit upon the Canadian General Electric Co., to whom it has been awarded.

A good evidence of the progress of Montreal as an electrical centre may be afforded by a visit to the new premises of John Forman, 708 and 710 Craig street. To accommodate his increasing business in electrical supplies, Mr. Forman has appropriated the whole of one of the substantial new buildings erected in Craig street in 1899. The new premises are four stories high, beside basement, and are admirably lighted and fitted up. The different departments are well laid out, both for convenience for shipment and for attaining the best effect in the show of goods. The basement is devoted to heavy goods, such as cables, heavy wires, conduits, insulators, etc., and is lighted by electric lights with double glass reflectors. A goods and passenger elevator connects the basement with the other flats. On the ground floor are the general offices, which are handsomely designed, and at the rear are supplies of various kinds. The first floor above this contains Mr. Forman's private office, and a new laboratory equipped with various instruments for testing incandescent lamps, etc., these instruments costing over $1,000. A noteworthy feature of this laboratory will be, that any person, no matter whether a customer of the firm or not, may have the benefit of these instruments, and no charge whatever will be made for testing lamps—beyond of course the cost of carriage from points outside the city. The privileges of this department will no doubt be appreciated by users of electricity. Portions of these two flats will be devoted to the display of electrical fixtures and supplies, and the two stories above these will be devoted to manufacturing. Mr. Forman has purchased the plant of the Canadian Bryant Electric Co., and will carry on the manufacture of all lines of supplies made by that company, including branch-blocks, mains, cut-outs, rosettes, switches, sockets, etc. The trade mark "Imperial" has been registered by Mr. Forman, and this striking emblem, which appears in his advertisement on another page, is sure to be a familiar one in the electrical field in future.

The McLachlan Electric and Gasoline Motor Co., Ltd., Toronto, has recently supplied the following: Duncan & McLennan, Campbelltown, N.B., two 50-light dynamos and one 3-h.p. gasoline engine; Hill & Rutherford, Victoria Glass Works, Toronto, one 15 and one 8-h.p. motor; Rodden Bros., Toronto, three 12-h.p. motors; Imperial Woolen Mills Co., Streetsville, 200-light, installation complete; Leitch & Turnbull, Hamilton, five 6-h.p. motors; Purdy, Mansell & Co., Toronto, two 6-h.p. motors; Douglas Ford, Toronto, one 8-h.p. motor; White, Allan Mnfg. Co., Toronto, two 3½-h.p. motors; T. Eaton & Co., Toronto, one 5-h.p. motor; E. B. Corlett, Toronto, one 2-h.p. motor; J. B. Kleinert Rubber Co., Toronto, one 3-h.p. motor; McKenzie, Snyder Co., Toronto, one 12-h.p. motor; Temple Building, Toronto, one 6-h.p. motor; Thompson Bros., Toronto, one 4-h.p. motor; A. E. Long, Toronto, one 2-h.p. motor; A. R. Williams & Co., Toronto, one 10-h.p. motor; O'Leary & Robillard, Ottawa, one 8 and one 15-h.p. motor; W. R. Robertson, Brantford, one 1-h.p. motor; Continental Costume Co., Toronto, one 6-h.p. motor; Capp & Co., Toronto, one 3-h.p. motor; H. W. Petrie, Toronto, one 2 and one 8-h.p. motor; Gold Medal Mnfg. Co., Toronto, one 25-light dynamo, full installation; Walter Dean, Toronto, one 6-h.p. motor; Mathew Bros., Toronto, one 30-light dynamo, full installation; Wm. Meek, Kingston, one 2-h.p. motor; John Henry & Sons, Ottawa, one 8-h.p. motor; Murray Printing Co., Toronto, one 12-h.p. motor; H. W. Petrie, Toronto, one 60-light dynamo and one 8-h.p. motor; Tarbox Bros., Toronto, one 3-h.p. motor; Mrs. Frero, Toronto, one ½-h.p. motor; Meteorological Office, Toronto, one 1½-h.p. motor; Dancyger Safety Pin Ticket Co., Toronto, one 3-h.p. motor; G. T. Pendrith & Co., Toronto, one 2-h.p. motor; Meyer & Shapro, Toronto, one 2-h.p. motor; Jas. Goldie, Guelph, one 5-h.p. motor.

Railway Matters.

The Grand Valley Railway, which proposes to build lines from Goderich to Port Dover and Stratford, Ont., has given notice of application for incorporation.

In Lindsay, Ont., a by-law was carried to grant a bonus of $25,000 to the proposed Lindsay, Bobcaygeon & Pontypool Railway. The township of Verulam voted $14,000, and the town of Bobcaygeon, $11,000.

The Pontiac, Pacific Junction Railway Company, will apply next session for right to construct a railway from Quyon or Shawville, Que., to Pembroke, Ont., and branches not exceeding thirty miles.

Logan, Jenks & Outhetо, of Amherst, N.S., give notice of application for the incorporation of a company to build a line of railway from Pyramid Harbor by the Dalton trail to Fort Selkirk, and on to Dawson.

Prof. C. H. McLeod, C.E., and a party of fourth year students have surveyed a cut-off line at Hamilton, Ont., to relieve traffic on the "Y" for the use of the through traffic, near Waterdown station. The grades have been much improved.

The Canadian Pacific Railway will construct or acquire a railway from Morden on its Pembina Mountain branch, to Miami, and to Carman, Man.; and also a railway from a point between Hartney and Souris on the company's Souris branch, to a point between Boissevain and Ninga on the Manitoba and Southwestern Colonization Railway.

Application will be made for a charter to build a railway from the mouth of the French River, in the Parry Sound district, through the districts of Parry Sound and Nipissing and the county of Renfrew, Ontario, to Pembroke, thence through the county of Renfrew to a point at or near the village of Portage du Fort, Que., with power to erect bridges across the Ottawa River, etc.

A serious landslide occurred at Kaslo, B.C., last month. A strip of water front eighty to a hundred feet wide, and 250 feet long, at the Canadian Pacific Railway landing, sank. All the piling which the C.P.R. has been driving for the past season, on which to build its wharves, and which would have been completed in a short time, dropped out of sight without a moment's

notice. The two wharves were being built side by side, that of the C.P.R. having about 100 feet of work done upon it, while the Kaslo and Slocan Company's was about completed. The last pile was being driven when the collapse occurred.

M. H. Fitzpatrick has in conjunction with his brother, Hugh Fitzpatrick, Pictou, N.S., about completed the Midland Railway of Nova Scotia, the promoters of the line being W. Strachan, D. L. Lockerby, Peter Lyall, W. D. Reid and others of Montreal. If it were not for the heavy bridge over the Shubenacadie River, fifteen miles west of Truro, N.S., passenger trains could be run over most of the line, but the delay at the bridge will probably delay the opening of this railway till the early autumn of 1900. The New York Engineering Company has built the two abutments and two piers of this bridge, leaving three piers to be constructed next summer.

F. H. McGuigan, general superintendent of the Grand Trunk Railway, recently said that the G.T.R. has laid, during 1899, 13 miles of double track and has the whole line doubled between Montreal and Hamilton, except 46 miles, from Port Union to Port Hope. If business is good, this link will be closed up in the near future. The double track from Hamilton to Niagara Falls is also laid out, and the work will be proceeded with next season. It has likewise been decided to double the line from Port Huron to Chicago in the near future. No less than 315 miles have been relaid this year, with new 80-lb. steel rails, while 285 miles of these rails, replaced by the 80-lbs., have been laid down on the branch lines, the latter being from 72 to 79 lbs., and replacing in turn rails of from 56 to 60 lbs. So it will be seen that no less than 600 miles of the company's lines have been greatly improved. From Portland to Chicago there are now laid 720 miles of these standard 80-lb. rails, while the steel in the balance of the main line between those points average from 72 to 79 lbs. They have laid, during 1899, 1,826,857 ties, 1,344,374 being cedar, and purchased in Canada. The company put down last year 321 miles of gravel and 50 miles of cinder ballast, 123 miles of new fence and 63 miles of yards and sidings.

Marine News.

Over 40,000 tons of coal have been brought to Sarnia, Ont., this fall by vessels.

Water was turned into the Chicago Drainage Canal at 9 o'clock, January 2nd.

The St. John Sulphite Fibre Co. has bought barges to use in bringing pulp up from the mill at Mispec to St. John, N.B.

At a meeting of the shareholders of the Sydneys' Ferry Co., Ltd., held in December it was decided to buy two new steamers for their ferry business next season.

H. W. Kennedy, M. Brown, W. Ross, and G. C. Frisbie, Rat Portage, Ont., and A. R. Bartlet, Windsor, Ont., have been incorporated as the Commercial Dock Company of Rat Portage, Ltd.; capital, $10,000.

Steamer "J. L. Nelson," built by W. H. Butler, of Yarmouth, for T. F. Smith & Co., of Newdy Quody, Halifax county, has been successfully launched. The new steamer is 68 feet long by 13½ feet beam and 7 feet deep. She is fitted with 7 x 14 x 12 compound surface condensing engine and a boiler 9 x 4 x 25 feet, carrying a working pressure of 140 pounds.

The United States project to place a dam across the mouth of Niagara River to permanently raise the level of Lake Erie some three feet is assuming a serious and tangible shape. It has been recommended by the Deep Waterways Commission, and Representative Corliss, of Detroit, is preparing a bill to bring before the United States Congress making an appropriation for construction. Of course the co-operation of the Canadian Government will have to be secured before the scheme can be gone on with.

—The Pratt & Letchworth Co., Buffalo, have bought the G.T.R. car works at Brantford, Ont., and will produce malleable iron for the Canadian trade.

FIRES OF THE MONTH.

Dec. 7th. The McLaughlin Carriage Co.'s works, Oshawa, Ont.——Dec. 10th. The Exeter, Ont., electric light station.——Dec. 11th. H. Kreig's woodworking shop, Hespeler, Ont.; engine house destroyed.——Dec. 12th. Owen Sound Iron Works pattern shop.——Dec. 14th. Machine shop of the Shore Line Railway, St. George, N.S.——Dec. 14th. Steamer belonging to G. F. Marsh, tug belonging to Shaw, Cassels & Co., at Huntsville, Ont.; loss, $6,000——Dec. 18th. Shearer's lumber mills, Point St. Charles, Montreal; loss, $20,000.——Dec. 20th. Charite L. Patterson Mnfg. Co., makers of tar paper, Halifax, N.S; loss, $5,000.——Jan. 3rd. H. C. Rees' stave mill, Woodslee, Ont.; loss, $3,000.

—Inglis & Sons, engine and boiler makers, Toronto, are about to build refrigerating machinery on a large scale.

—F. Moore, of the Jones & Moore Electric Co., Ltd., Toronto, has been for some weeks suffering from a severe attack of typhoid fever.

—Henry Aylmer, Melbourne, Que., intends to establish a large sash and door factory and sawmill. Electric power will be used, it is said.

—Sproatt & Rolph, architects, Toronto, have prepared plans for a glycerine refining plant to be installed in connection with Lever Bros., soap factory, Toronto.

—C.A.S.E. Toronto No. 1, at its regular meeting, January 3rd, elected A. M. Wickens and Chas. Moseley as representatives of the C.A.S.E. on the Board of the Technical School. At the open meeting on January 17th, J. Hunter will read an essay on "Refrigeration."

—The Hamilton Bridge Works Company, Ltd., has issued the following circular: "We beg to announce that W. H. Law has been appointed chief engineer and manager of this company. H. Szlapka will remain with the company, attached to the engineering staff." Mr. Law, who was formerly general manager of the Central Engineering Co., of Peterboro, has been heartily congratulated by his friends from many quarters on this return to his own special field.

FOR SALE

A good Water Power, 500 horse, situated one-half mile from railway, every facility for making siding to power. Address

J. D. THEUNISSON, Cookshire, Que.

Bridge Tenders Wanted.

Sealed Tenders (marked tenders for bridge) for the superstructure of a steel bridge over the South Nation River at Lemieux, on the boundary line between Prescott and Russell, Ont., will be received by the undersigned up to the 20th January next, inclusive (1900).

Separate Tenders for the construction of the "abutments" of said bridge will be received by the undersigned up to said 20th day of January next, inclusive.

Plans and specifications of said bridge (iron work and masonry) may be seen and further information obtained, at the office of the undersigned, in the Court House in the Village of L'Orignal.

The lowest or any tender not necessarily accepted.

E. ABBOT JOHNSON,
Clerk United Counties of Prescott and Russell.

L'Orignal, December 12th, 1899.

ELECTRIC BARGAINS

We have on hand for immediate delivery a number of motors from HALF H. P. to TEN H. P. standard voltages and makers. These motors are in first-class order, some of them having had but little service, and to clear them out quickly we will sacrifice. Write us at once stating your requirements, and receive our prompt attention.

THE JONES & MOORE ELECTRIC CO.
TORONTO, ONT.

The Canadian Engineer

VOL. VII.—No. 10. TORONTO AND MONTREAL, FEBRUARY, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE
CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,

E. B. BIGGAR
R. R. SAMUEL

Address—Fraser Building, MONTREAL, QUE.

Toronto Telephone, 1392. Montreal Telephone, 2589.

UNITED STATES AGENT:
H. E. BURNETTE, Cor. Fourth and Locust Sts., Philadelphia.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Automobile Notes	279
Canals, The, of Canada	266
Canadian Association of Stationary Engineers	276
Catalogues, New	276
Canadian Society of Civil Engineers	278
Combustion	273
Electric Flashes	284
Fires of the Month	277
Heating and Ventilation, School	278
Heirs Wanted	277
Industrial Notes	281
Lake Levels	264
Literary Notes	278
Manual Training in Public Schools	270
Marine Engineers, The	278
Marine News	286
Markets of Canadian Goods in Great Britain	277
Measures and Rules	288
Metal Imports from Great Britain	288
Minerals, Ontario	277
Mining Matters	287
Oilstones, How to Select and Use Them	275
Pumps, Interchangeable Oil	274
Personal	284
Railway Matters	286
Railway Building in Manitoba	274
Stoker Company, American vs. General Engineering Company	277
Steam Trap	272
South Africa, Its People and Trade	265
Temperature	277
Water Supplies	263
Water Pressure	265
We are Well Hated	276

FOR THE CANADIAN ENGINEER

WATER SUPPLIES.

BY W. M. WATSON.

(Continued from last issue.)

The need of sufficient water pressure is often a danger to the public health. Last September I was staying at a prominent hotel in one of our great cities, and while on the top flat I heard the water closet cistern (a noiseless syphon flushing cistern) syphon the water out of the cistern back into the town supply service. On examination I found that the pressure was so poor that when they drew water at a lower flat the water was sucked out of the closet cistern and drawn out of the taps below. This was very serious for the health of the household, because there would be a passage of the foul gases contained in the closet bowl upward, through the flushing pipe, and into the flushing cistern when syphoned empty, and when the cistern was refilled with water it would be fouled by these gases, and if they happened to draw the water again at the lower rooms before the w.c. was used they would be receiving poisoned fluid. A similar case occurred at the Caius College, Cambridge, where a violent and disastrous outbreak of typhoid fever occurred because one of the water closets that was flushed by a dangerous old-fashioned stool tap, out of repair, and not having sufficient hydraulic pressure behind it from the water mains, allowed the contents of the water closet bowl to be sucked back into the service pipe and delivered to the kitchen.

At Mountain Ash, in Glamorganshire, the people were struck with an epidemic of typhoid, and Mr. Spears proved it to be caused by a water main being laid for a long length alongside a very foul old stone sewage drain, and the poisonous gases had been attracted through the walls of the iron-pipe main into the motionless water when there was no one drawing. When the main was removed out of the way of the sewer the outbreak diminished and has since not occurred again. (See health reports of Great Britain for 1887.) In an English manufacturing town I examined about fifty sets of steam boilers which were supplied direct from the town's water mains and found only about twenty per cent. that were supplied with proper valves and other appliance in sufficiently good working condition to prevent the fluid from the steam boilers leaking back from the boilers to the water mains when the steam pressure in the boilers was higher than the water pressure in the mains, and sometimes the ingredients used to prevent the boilers scaling could be tasted in the water drawn at the taps of the houses situated in the immediate neighborhood.

The insuction of polluted water and foul gases into water supply mains of towns, and the illnesses caused therefrom, does not receive the attention it should, for it is of little use securing good water at the intake if it becomes contaminated after entering the town supply pipes.

But the intake end of the service should also be watched, because what sometimes seems a very trivial affair turns out to be serious. In 1892 a number of Russian Jews from the cholera stricken districts of Russia squatted on the quays of the river Elbe and the sewage from them was washed up by the tide to the mouth of the intake pipe that supplied the city of Hamburg with water, and in the space of eighty days 18,000 persons were attacked with cholera and 8,000 died from the complaint. (See Professor A. Koch's report).

During a general heavy rain or thaw of thick snow the face of the earth is washed and its impurities, coupled with the ejecta from men, animals, and birds, together with every description of decayed and putrefactive matter, is discharged into the rivers, making the waters they are carrying away totally unfit for domestic consumption for probably a whole week, and this makes it almost imperative for towns who draw their supply from drainage rivers to have a reservoir accommodation to hold over one week's supply, so that the river supply may be dispensed with during such periods, or else they should be provided with good filters.

There is a purifying advantage in storing water in reservoirs, for water allowed to rest in reservoirs for a few days improves considerably in quality if the reservoir is clean. It seems to go through a process of mild fermentation, and the friendly cleansing microbes feed on the injurious germs that the water may contain. No doubt a similar purifying process goes on in slow moving rivers, probably in a rather less degree, but it cannot be expected that the germs cast off by diseased persons and putrefactive

substances will be extracted by this process when passed into the river as sewage, because sewage waters need thorough shaking and mixing with fresh water before they both can be incorporated and the purifying influence of fresh water have a telling effect on the sewage. This fact has caused the British Government Board of Health to say that they know no river of sufficient length to thoroughly oxidize sewage fluids so as to be safe to use for domestic purposes.

Dr. Frankland assures us that dangerous microbes that cause epidemic diseases are held in suspension by the waters and do not settle down with the dead organic matters termed the heavy solids, to the bottom of the rivers or reservoirs. Dr. Thresh has proved by tests and close investigation that the poisonous germs cast off by diseased persons have been still alive and dangerous after traveling in river water for 168 miles at a speed of one mile an hour, though the germ-carrying sewage had become well clarified and clear. He also bears out Dr. Frankland's statement that the disease breeding germs are held in solution in water after the sewage is cleaned and the sediment is separated. Several noted biologists hold the opinion that when river water is specifically infected with germs ejected from persons or animals suffering from epidemic diseases they cannot afterwards be sufficiently purified to be safe for use for drinking purposes for a long period after contamination, however far they are carried with the stream.

The effect of the sun's rays upon water containing organisms is beneficial. Professor Buchner proved this by placing gelatine plates closely sown with live typhoid bacilla in water, at various depths, for a period of over four hours and exposed to the rays of the sun, when he found that all the plates that had been placed less than five feet deep were sterilized; this proves that the sun can do purifying work to a depth of five feet in clean water. Dr. Thresh and others state that typhoid ejecta loses its virulence within fifteen days, but in that space of time it may travel and convey the disease to persons 400 miles from the place from which it started.

I stated and showed clearly in my first article on water supplies that people may get accustomed to swallow contaminated water with impunity without ever being seriously and violently affected, but the act runs down the bodily system and makes life less enjoyable and shorter than if pure water was always used. This statement was proved in a very remarkable manner at the town of Newark, England. For many years that town took its water supply from the river Trent, and to be sure to have it palatable they filtered it, but the death rate for a rural, healthy district like Newark was high, and it was decided to secure the town's supply from deep wells, and abolish the use of river water. The waterworks system was totally changed in August, 1893, and proved to have a surprising beneficial effect. I herewith give the number of typhoid fever cases of that town for six years, which was supplied by Dr. Wills and published by Dr. Thresh in his reports (page 224). Newark on Trent has a population of 14,500:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1890	1	4	1	2	3	3	3	1	1	6	20	8	53
1891	25	17	8	5	5	0	12	7	14	12	15	5	125
1892	1	1	0	5	1	3	5	12	12	7	12	10	69
1893	16	16	3	5	4	5	5	8	5	4	4	2	78
1894*	1	0	0	0	0	0	0	2	1	2	3	1	10
1895	1	0	0	0	0	1	0	0	1	1	3	0	7

*The new water supply.

This table of figures speaks for itself and proves the advantages derived from a pure water supply. It is not always the best policy to extend intake pipes too far into the rivers, because the river may prove to be of better quality near the shore, and it is not hard to judge by the eye where good palatable water locates. For example I may state that this week I was over a part of the St. Lawrence River in a boat; on leaving the beach I sailed for several hundred feet over a beautiful bay of clear, bright, good water, resting on a clean stony bed, which could be easily seen at a depth of about nine feet, and appeared totally free from vegetable growth until nearing the main body of the river stream where the water turned a yellowish green and could not be seen through nearly so well. As this bay had a clean bed and was shallow for a good distance out, the water it contained would easily get aeration and have the full benefit of the sun's rays, moreover, the water coming from the surface of the main stream would be partly aerated and oxidized before it overflows sideways into the bay. This bay is really a self-cleansing reservoir kept clean at the bottom by slow circulation of the surface water of the river moving towards the beach and returning back to the main body of the river. That part of the river that is really the fringe or edge of the main stream is not of so good water, or so well sterilized as the water in the bay, moreover, it is the part of the river stream that carries the sewage from the towns situated higher up the river banks, for no sooner does sewage leave the mouth of the discharge pipe of the drain, than it makes a bee line straight down the stream and seldom passes to the main current in the centre of the stream.

In summing up the subject we may say that it is absolutely necessary to supply the public with water that is free from excrements and urine, also, any bodies or material that are in a state of decomposition or putrefaction, but I cannot admire such judgment as the citizens of Bradford, England, showed three years since when they compelled the waterworks committee to run to waste over 50,000,000 gallons of good water out of Chellow Dean reservoir because a person had drowned himself in it. The body was removed long before decomposition set in, therefore the immersion was harmless.

LAKE LEVELS.

Referring to our remarks in last issue on the subject of St. Lawrence levels, the Engineering News, New York, says: "Our contemporary is needlessly alarmed." The fact remains, however, that the situation is serious and that the outflow at Chicago by the canal will injure Canadian shipping enormously. The United States interests on the Upper Lakes may be protected by a dam on the Niagara River as recommended some time ago by the commission, and by a new Erie Canal as resolved on by Gov. Roosevelt's commission in the past few days, but these measures will not help the St. Lawrence Canals, they will make their maintenance a matter of purely Canadian interest, and it is necessary that public opinion should be educated on this important question. The Montreal Witness has an editorial under the head "Stolen Waters," recently, which takes a commendable position on this subject. The Engineering News in discussing the question refers to the capacity of the canal as "300,000 cu. ft. per second." This passing through a canal having a section 161 x 22 ft. would move at the rate of a mile a minute and the total flow per annum would equal the area of Lake Erie with a depth of say 35¼ inches. Taking our contemporary's own figures we need not be alarmed about the St. Lawrence levels, as there would be no St. Lawrence under those circumstances.

SOUTH AFRICA, ITS PEOPLE AND TRADE.

CAUSES OF THE BOER WAR.

ARTICLE IV.

(Continued from December Issue.)

The foregoing were a few out of many political grievances. On the top of these the people of Johannesburg in particular had their local or municipal grievances no less trying. The condition of Johannesburg has, like other matters in the Transvaal, been much misunderstood by outsiders. The Boer newspapers and public men have sought to make it appear that Johannesburg is made up of the offscourings of the earth, to whom it would be dangerous to give rights of self-government. In the early days, it is true, a great many adventurers came from all parts, but the town passed through that phase of life as all mining communities do; and for some years past it is no better and no worse than the average city of its size. It is not an alluvial mining diggings where men of every stamp can work their own claims, but a settled industry carried on by rock-crushing, as in the Kootenay, and necessitating expensive machinery and expert hands. Indeed, the mining machinery of the Witwatersrand is the most modern, as well as the most extensive in the world, many of the large companies having their own machine shops and operating large steam and electrical plants, with large staffs of the most skilled workmen. The manual labor is done chiefly by natives, but the mining and commercial business—the former having the cleverest mining engineers and experts in the world, and the latter, including branches of the most reputable firms of England, Germany, the United States, etc.—are carried on by white people, among whom there are practically no Dutch. Where there is so much gold production (the output last year was $75,000,000), there must be a large number of banks and financial corporations, which of necessity must have trustworthy employees, and so it must be said of business firms. Are the owners of these big mining plants, banks and financial houses likely to put their affairs into the hands of ruffians, drunkards, and thieves? If this question cannot be answered by a moment's reflection, the doubtful reader can satisfy himself by examining a copy of a recent Directory of Johannesburg, and read down the names and occupations. The same directory will show how unfounded is the statement that this agitation is purely a capitalistic one. Now imagine such a city of 80,000 * progressive and energetic inhabitants being governed by thirty farmers; and imagine the representative financial and mining body of the city (the chamber of mines) being refused an ordinary charter of incorporation, on the ground that it would be creating "a State within a State." At first, English-speaking men were chosen to the town council, but to cut them off from self-government, even in municipal matters, President Kruger decreed that only Dutch should be spoken in the council, and so the Anglo-Saxon was debarred there. And the Burgomaster (Mayor) is not elected by the voters, but appointed by the Government. The drainage of the city flows along the streets in open gutters, exhaling poisonous vapors, as was the case in the early days of Capetown, and the people are compelled to drink dangerously unwholesome water, with no power to alter the condition of things. Drunken zarps (policemen) swagger about brandishing revolvers, occasionally shooting down poor natives for some trifle, and insulting Uitlanders (who are not allowed to carry arms), whenever an excuse offers. The killing of Edgar by a squad of zarps, who broke into his house and murdered him in cold blood, as he was sitting on his bed talking to his wife, is a notorious example. The murderers were arrested, tried, acquitted, and some of them promoted. Such was the municipal condition of Johannesburg up to the present crisis.

The Boer Government of the Transvaal stands condemned by the liquor traffic. In theory, no liquor is sold to the natives, but in the large mining centres, particularly Johannesburg, the native laborers, who are herded in enclosures like cattle, are supplied with the vilest of intoxicating drinks, in such quantities that scarcely a day passes without one or more murders, brought about through drunken natives engaging in "faction fights." It is estimated that one-third of the total native labor supply is rendered non-effective, week in and week out, through natives being incapacitated by drink, while the damage to goods and machinery, through the same cause, is a serious item. So great did this scandal become that the Boer Church was shamed into strong representations against it last year, but though Kruger is himself an abstainer, he sided with the liquor dealers, and would do nothing, on the ground that if this traffic were stopped, a number of honest men would be put out of employment.

The operation of the liquor law in Johannesburg is thus described by a brother of the Rev. Chas. T. Cocking, of King, Ont., writing lately from the Transvaal: "Take the case of the liquor law, which prohibits sale of liquor to natives. Every Sunday one can see hundreds of natives wandering about the mines and suburbs of the town almost mad with drink. Kafir eating-houses are filled with natives drinking, and from which they stagger with sacks full of liquor to be swilled on the open veldt by fraternal groups. A special liquor detective department exists, and yet for twelve months this has gone on. Result? For two or three days following the debauch, hundreds of natives are unable to do their work, and remain sleeping off their carouse in the mine compounds to the dead loss of the mining companies. Cause? An immensely wealthy liquor syndicate, which, by bribery, etc., prevents the law being effective. The Government is so inconsistent as to absolutely prohibit natives from drinking, but a treaty with Portugal must allow the importation of Kafir liquors and spirits through the port at Delagoa Bay, and from the duty on which they obtain a handsome increase in the revenue."

(To be continued.)

*Besides the white population there were at the beginning of 1899, 90,000 blacks.

WATER PRESSURE.

Editor CANADIAN ENGINEER :

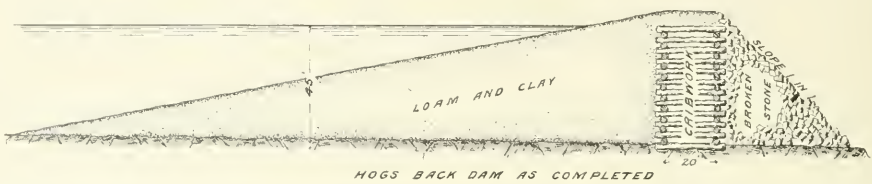
I would be pleased if the city engineer of St. John, N.B., would explain the last eight lines of the first paragraph, page 232, of December issue of The Canadian Engineer, where he shows that there was a great increase in the pressure of water because he caused three-quarters of an inch of calcareous matter to be removed from the inside of the water mains. It will be a great discovery if the head of water can be increased by increasing the size of the carrying pipe.

Toronto, January 15th, 1900. CORRESPONDENT.

THE CANALS OF CANADA.*

(Continued from last issue).

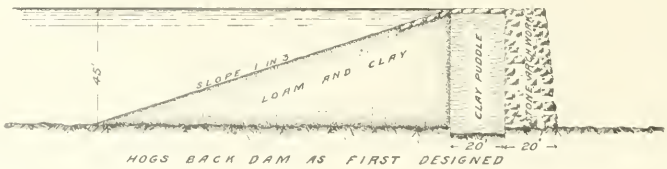
Again with a regular canal in times of flood the engineer simply closes his guard gates and lets the angry river sweep by, but if he has dammed right across it he must be prepared to cope with and tame its fullest strength. More than one dam, built in the most approved materials of modern engineering, has gone down before such floods, and the best method of building such structures is still a matter of controversy. The boldness of these pioneer engineers can be best judged by their own recital of the disasters that befel their first dam. This was the Hog's Back dam, which is situated close to Ottawa, and at a point where the level of the water had to be raised 45 feet. The river was 170 feet wide, and in 1827 a dam was constructed half way across the river. It was built on the authorized plan; that was, an earth structure which was rendered water-tight by clay puddle and supported on a great dry stone wall built in an arched shape of large stone set on edge. Then the contractor attempted hurriedly to block the other half of the river by a dump of what



HOGS BACK DAM AS COMPLETED

the Royal Engineers called rubbish, but no provision was made for the water, and rising, it swept over the rubbish and carried it all away. A rough timber dam was then thrown across the opening in order to protect the finished part of the arch, but the spring floods overtopped this, swept it also out and cut a new channel around one end of it. The gap was again closed in the simple method followed by our lumbermen in building their driving dams, and under this protection the great arch was at length completed, and by March, 1830, the dam seemed safe. But the river rising in spring flood worked through the ill-packed clay and puddle, and on April 3 the stone work fell with a great crash, and the river swept on its course once more. The Royal Engineers write that they saw that day an extraordinary exhibition of the power of Canadian frost, for while the turbulent stream swept through, the top of the dam remained standing, an earth arch of over 50 feet span. The dam was finally completed by building the lumbermen's cribs right across, backing them with broken stone, and dumping earth and clay in front, and providing ample by-passes for the flooded river. The lessons its construction taught have been well learnt, and no man would to-day build an earthen dam that the river could overtop, nor attempt any construction without providing ample by-passes while his works were in progress. The still recent failure of the dam on the South Fork of the Conemaugh river was caused by the blocking up of its waste weirs or by-passes, and the destruction of Johnstown and of the railroads in the Conemaugh valley was a terrible demonstration of the power of a flooded river that has broken its dams. The Rideau Canal is a succession of pools formed by dams like that at the Hog's Back, lift locks being built near the end of the dams. These were of rubble masonry laid in lime mortar and faced with cut stone. Considerable difficulty was experienced with the masonry owing to the poor quality of puddle used around the walls, and the total unsuitability of lime mortar for such work. This was finally overcome by making a special cement at Hull, for our modern hydraulic cements were then unknown, and grouting the finished walls with it through long tin tubes let down in holes drilled in the masonry. The vertical lift of these locks varied considerably, but it was necessary at some places to place several locks together to overcome the rise at those points. Thus at Ottawa a rise of 81 feet is overcome by eight locks in a flight.

The delay and inconvenience to traffic of such an arrangement has been found to be very considerable, and in the canals now building it is carefully avoided. The Trent Navigation is a system of canalized rivers connecting natural lakes, very similar to the Rideau, but on that work the engineers are building hydraulic lift locks where a great rise is to be overcome at one point. These are a distinctly modern device, and pending the completion of the Trent lock, the most notable of them in service is that at La Louviere on the Belgian State canals. The upper and lower reaches of the canal are closed by vertically sliding doors, and the lock is simply two great steel troughs, carried on girder work very similar to that of a railway bridge. The troughs are closed at the ends by doors like those on the ends of the canal, and each trough runs up and down between braced steel guide towers. Under the centre of each trough is an enormous ram, and the cylinders in which the rams work are connected together so that one lock in descending forces the other to rise; and in practice the lock is actually operated by allowing the water in the upper trough to become a little deeper than that in the lower, the weight of this extra water supplying all the power required for the lift. The trough becomes part of the upper or of the lower reach according to its position, the gates being run up far enough to clear the barges. The rise at La Louviere is 50½ feet, and the lock will lift barges carrying 400 tons. The Trent lock will have 15 feet more rise and will handle much heavier boats. The time of passage through one of these locks will not differ materially from that required for a gate lock, but it has a much greater lift, the maximum on the Canadian gate locks being that recently adopted for the Soulanges canal, 23¼ feet; it has also the advantages of giving a passage up and a passage down at the same time, and of requiring very little water to operate it; a feature which recommends it strongly to the Erie canal engineers, that work being badly handicapped by lack of water. It is not at present considered suitable for the great locks of the St. Lawrence system.



HOGS BACK DAM AS FIRST DESIGNED

That the Royal Engineers were wise in their decision to raise the levels of their rivers rather than attempt to excavate canals, seems to be proved by the history of the first Welland canal, which was built at the same date. It was proposed that there should be no locking up from Lake Erie, and the "deep cut" near Allanburgh was undertaken with that end in view. An excavation varying from 30 to 55 feet was required for about a mile and three quarters through a heavy clay, underlaid with treacherous unstable material resembling quicksand. When this was about two-thirds completed tremendous slides occurred blocking the canal and rendering necessary the raising of the summit level, and the building of a 21 mile feeder to obtain water to operate that level. Those slides remained an obstacle

*From a popular lecture by J. G. G. Kerry, B.Sc., before the Applied Science students of McGill University.

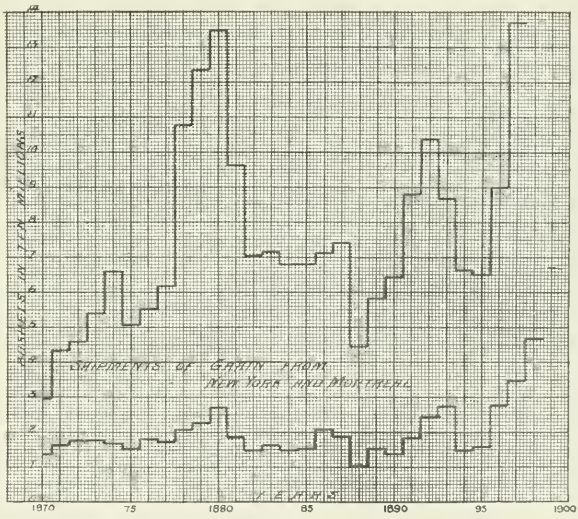
to our commerce until after 1870, for in spite of all improvements and enlargements it was not until that date that the cut was excavated to such a depth that the Erie level could be carried through.

The Soulanges canal may be taken as the most advanced type of canals proper. It is a built canal for its entire length of 14 miles, and has a waterway 100 feet wide at the bottom, with side slopes of 2 to 1. The banks of the canal near the water line are protected from the wash of the swell of passing vessels by a layer of broken stone. The excavation of the material for the waterway involved enormous quantities, but the perfection of modern contracting plant rendered it easy to handle the material at rates that would never have been thought of in the construction days of the Rideau; and, although its route did pass through material well nigh as unstable as that on the Welland, the great slips that have occurred have been readily taken out by the contractors. The Soulanges canal has no lack of water to fear, for its summit level is that of Lake St. Francis, and like all the St Lawrence canals it has the great river to draw from. But though the flow of the St. Lawrence may be ample its depth is not always so, as the shippers of Montreal well know from recent experiences in the ship channel, and in this particular the engineers of the Soulanges have made more ample provision for unprecedented low water than has been made at Lachine and Cornwall, for on those canals of nominal fourteen feet draught, the water has sometimes been less than thirteen feet deep. There is also grave reason to fear that the opening of the Chicago Sanitary Canal will divert so great a flow from the St. Lawrence that in low water seasons the river level will sink lower than ever before, and that the efficiency of our most important canals will be seriously impaired by this local American work, for unfortunately, the time of low water is coincident with the time of heaviest trade, and then every inch of draught means much to our forwarders. As in the Rideau, the heavy fall of the Soulanges comes at one point, but here in order to avoid a flight of locks short stretches of canal with large equalizing basins are built in between the separate lifts. The locks themselves are built of concrete, and faced with cut stone. Their magnitude can only be realized when standing in them, for the size of a wall 22 feet thick, and 41½ feet high, is not easily grasped from the figures alone.

There are several details that are worthy of note in these locks. The breast walls at the upper end are reintroduced, as it is found that the most fruitful cause of accident in canals is the collision of an upcoming boat with the upper gate, and breast walls will prevent this. The gate valves for letting the water in and out of the locks, and that we are all so familiar with, have been abandoned, and the water flows through great culverts in the heart of the wall. The flow through these culverts is regulated by vertically moving valves called Stony sluices, a device adopted from the Manchester Ship Canal. The familiar winches for operating the gates will also be missing for these, themselves nothing but a pile of great beams of British Columbia fir solidly bolted together, will be moved by heavy struts attached a little above the centre of the gate and working in recesses in the walls. The power for all this movement, and for the lighting of the canal from end to end at night will be electricity, and will be obtained from a special power-house, built in the bank of the canal, and utilizing its surplus flow.

Special channels or by-passes are built around each of the locks by means of which water for the reaches below can be supplied without flowing through the locks themselves. These by-passes are spanned by stone bridges at each end, and the discharge through them is controlled by a set of automatic Stony sluices built directly across the by-pass at the centre. Long walls of cribwork run out into Lake St. Louis and Lake St. Francis at either end of the canal, but there is a novelty in their design also. For the cribwork is only carried up to within a foot of low water, and above that these quay and anchorage walls are all concrete.

The line of the canal is intersected in several places by roads and streams, and provision has had to be made for their crossings. The roads are carried on swing bridges as is customary, but these are specially designed so that there is no masonry to interfere with the clear waterway of the canal, and an extra channel is excavated around the swing pier of the bridge. The opened draw is completely on one side of the canal proper. The piers are of concrete and the scaffolding in the slide is typical of that used for all the structures. It is not an easy matter to cross a large stream with a canal, for the level of the canal is usually about that of the stream, and although the latter's low water flow might be a desirable addition to the resources of the canal, its flood tide would be far too strong to be accommodated in so artificial a channel. The main stream that crossed the Soulanges location had a flood discharge greater than that of the Rideau at the time of the Hog's Back disaster, but it and all other streams have been quietly passed under the canal by means of lines of cast iron pipes, set in concrete. The Delisle River required 4—10 ft. pipes to give it free passage. The St. Lawrence canals are all built to the same general dimensions, but the details of the Soulanges are more complete than those of the earlier finished canals. The locks are much larger than those of the Ottawa and Chambly canals, but are after all only modern developments of the original type which they well illustrate.



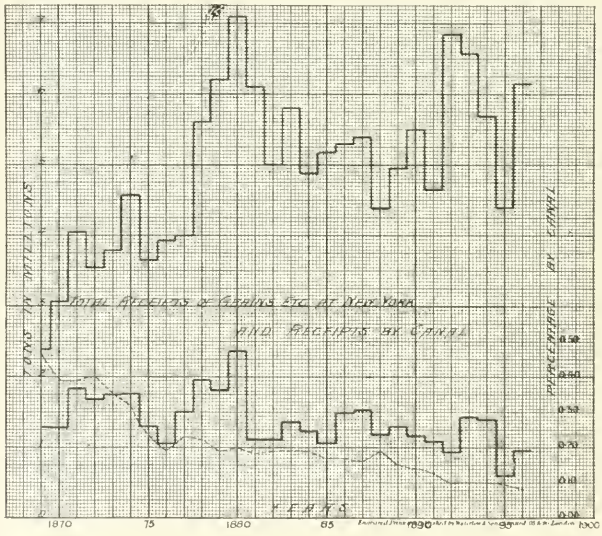
Turning now to consider the canals from the point of view of the commercial public, it must be admitted at the outset that they have failed to fulfil the expectations of their designers. In the case of the smaller canals the reason for this is not far to seek. In England and in the United States no stocks have

suffered such a tremendous decline as those of the canal companies, which at the beginning of this century were considered the most desirable of investments; and the same competitor that has ruined, and so often absorbed those canal companies, has taken away from our canals most of the freight that they were designed to handle. Half a century ago, just on the completion of our St. Lawrence system, T. C. Keefer, C.E., was quietly prophesying that in a few years the railroad would leave nothing for the river but "emigrants, pork, flour and lumber," and the event has proved him to have been more than right. In Europe, the canal remains a great and valued part of the transportation systems, but the conditions that make barge canals profitable there are not found here. The American transportation problem has been a peculiar one, and it has worked out its own solution largely in special long-haul low rate freight railroads, which have been developed to meet the needs of a restless and energetic people, of great commercial activity and impatient of all restraint, struggling against the disadvantages of a northern climate and of a sparse population scattered over widely extended areas. The smaller canals, both in Canada and the United States, have not been able to hold their own against such competitors.

The traffic on the St. Lawrence system is worthy of a more detailed study, for it was built for the one purpose of winning for the river the export trade of the west, and it has not done

last thirty years it has resulted in a steady diminution in the canal traffic, although the tolls have been steadily reduced, and finally abolished in 1882.

It was in the hope of capturing this Erie Canal traffic that the St. Lawrence canals were built, and the great expenditures made by the Canadas in the early days do not appear so extravagant, when we remember how great was the toll collected by the rival route at that time. Col. Philpotts in his report, previously referred to, pointed out how marked would be the superiority of the St. Lawrence route if its canals were made large enough to permit the passage of the lake vessels to Quebec without breaking bulk, and how great a share of the traffic such an improvement would divert, but he does not seem to have fully considered the influence of the vested interests and established trade routes of New York. The clearest proof of the impossibility of natural advantages alone changing the channels of trade is in the fact that although the Welland was long the smallest of our canals, about half of the traffic passing through it was diverted from the St. Lawrence route and sent to New York through the Erie canal via Oswego by American forwarders. This fact is but another tribute to the superior energy and resource of our New York competitors. Col. Philpotts' idea was that the lake carriers should be brought through to Quebec with full cargoes, but this was rendered impossible by the small size selected for the Welland locks on its enlargement in 1848, and the possibility of car-



so. The principal reasons of this failure are the commercial inactivity of the Province of Quebec, the disproportion between the canal locks and the vessels carrying the lake trade, and the great changes in the positions of the world's manufacturing centres since the system was first projected. That we have been completely outdistanced by New York in the struggle for the western trade must, in large measure, be attributed to the superior commercial genius of its people. Early in the century the New York statesmen saw that the Great West, then just opening up, must become commercially tributary to the St. Lawrence, unless they could provide a competing water route, and with the steady purpose of securing that trade they completed in 1825 the Erie Canal. Perhaps no transportation work has ever been so completely successful both politically and commercially. It fully achieved its purpose, and from the hour of its completion New York became the commercial capital of North America. For many years it was crowded beyond its utmost capacity, its locks worked continuously night and day, and the revenue from its tolls was so great that when the railroads parallel to it were first opened they were forbidden to carry freight lest they should diminish the income of the State. But with the removal of this embargo, and the development of railroading consequent upon the introduction of the Bessemer steel process, the competition grew more and more keen between the two systems, and for the

rying out his idea has never yet arrived owing to the fact that the dimensions of the lake carriers have always increased more rapidly than those of the locks of our enlarging canals. With a strange lack of foresight, in which, however, they were amply justified by the statements of the most prominent forwarders of the day, the Canal Commissioners of 1871 determined the dimensions of our now nearly finished system; and after pointing out that when Col. Philpotts' recommended locks of 750 tons capacity there were then boats of 800 tons on the lakes, and that there were boats of 1,600 tons at work in their own day, and that no man could prophesy what the increase of a few years would be, they calmly recommended locks that would not pass the largest vessels of their own day; so that when the enlargement of the Welland was completed in 1887 it was more out of date than it was in 1871. Vessels at present carry about 1,800 tons through the Welland, and will be able to descend to Montreal upon the completion of the Soulanges, but the great grain carriers of the lakes now run over 6,000 tons. T. C. Keefer, writing in 1893 recommends that the locks of the canals be lengthened, as the first step in their further improvement, pointing out that although in modern steamers the proportion of breadth to length varies from 1 to 8 to 1 to 10, our commissioners adopted those of Noah's ark and made the locks 1 to 6. The most economical size and draught of steamers is a matter of controversy, and for

ocean steamers the largest are now greatly preferred, but Mr. McDougall, the designer of the whaleback lake fleet, for which the highest efficiency in service is claimed, has stated recently that of all their boats, they believe that those suited to the Canadian canals will make as good a showing as any of the larger vessels. The promoters of the Trent Navigation are of the same opinion, and claim that the present craze for large lake ships is without satisfactory foundation, and say that they will be able to compete on even terms for the grain trade over their land-locked barge route from the Georgian Bay to Montreal; but the truth of this claim remains to be tested. The failure of the Erie Canal in its struggle against the railroads, they ascribe to a communistic law which forbids any company with a capital of more than $50,000 to operate on that route. As the great transportation companies now reach after their traffic for thousands of miles, it can easily be realized how hopeless it is for a small barge owner to secure the carrying of that traffic for but a portion of the way.

The completion of the Erie Canal by centering the export trade at New York made it also the importing centre of the continent, and the forwarder by the Erie route was nearly sure to secure a return cargo for his boats, and the influence of the great importing firms thus tended to draw the export traffic from the St. Lawrence, and it would only have been by the growth of a mercantile community in Montreal equal in wealth and enterprise to that of New York that that advantage could have been offset; and any attempt at American importation via the St. Lawrence was rendered impossible by the attitude of the United States custom officials. The disproportion of trade in the St. Lawrence, and also in the export and import trade of Montreal itself has always been very great. This

centre Montreal is unfortunately greatly handicapped by her distance from a winter port, and it is much to be desired that the late suggestions of T. C. Keefer with regard to keeping the St. Lawrence open in winter should be given a thorough trial. This has frequently been pronounced altogether impracticable, but until it has been thoroughly tried with modern ice-breaking steamers no man is really in a position to make this assertion. If the river could be kept open even to Quebec the advantage to Montreal, and to all routes leading to Montreal would be very great. The canals themselves will, of course, never be kept open for more than eight months as an absolute maximum. It is well to state here, however, that although competitively our St. Lawrence canals have not succeeded, they have always been of great absolute importance to this city for almost all the grain for export, and a large proportion of the lumber, has been brought by barges, and it is its great export rather than its import trade that maintains the harbor of Montreal. The canals were for many years the practical link that held the Canadas together. The facilities that they furnished contributed greatly to the building up of Ontario, and they have been indispensable to purely Canadian trade, and have only failed in the effort to turn the trade of New York to Montreal.

There are three canal schemes now attracting the attention of the Canadian public. The first is the old Trent Navigation, commenced in 1837 and discontinued in 1841, and again taken up about 1882 by the Dominion Government. Several references have been made to it in this lecture, and active efforts are being made to secure the necessary appropriations for its completion. It will open up a local trade route of great length, and its promoters expect by a well organized barge service to secure a large proportion of the through eastward traffic.

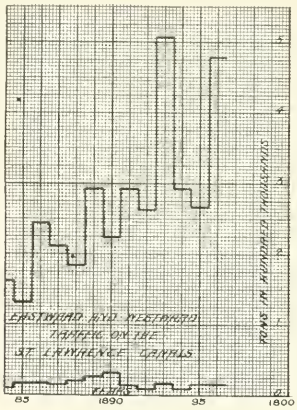
impossibility of securing return cargoes has been keenly felt by our forwarders, and the early canal builders hoped that the low freight rates that could be made by the St. Lawrence would induce heavy shipments of coal, iron and salt up the river, but the growth of the manufacturing interests on the lakes, where these raw materials are now mined in greatest abundance and at the lowest figures in the world, have destroyed this hope of westward traffic.

For the future our forwarders can only hope to compete for the grain export trade, of which we handle at present but a tithe, although our shipments for 1898 were unprecedented. This increase must, however, be largely ascribed to the activity of the Canada Atlantic Railway which, unlike the Canadian Pacific and the Grand Trunk, catered vigorously for the grain trade, and at prices practically equal to those offered by canal. It will therefore be a matter of great interest to observe in the future the contest between our 14-ft navigation, and this energetic railroad, which is so situated that the grain traffic is almost an essential to it. Certainly the cost of grain transportation has now become much less than the fluctuations of the market price of that commodity. We have also something to hope from the development of heavy manufacturing interests, now taking place in the Province of Quebec; for an active commercial population here would contribute more to the prosperity of our canals than any other probable event. It is also possible that, if the present hostility to our interests evinced by our American neighbors continues, we may be forced to build against them a tariff wall, as high as that which they have so persistently erected against us; and that will mean that much of the coal and iron that is now imported from the States will have to be brought from England and the lower provinces, and will move westward over the cheapest route, that is by the canals. As an importing

The western shippers have long been anxious for a deep waterway canal to the sea, and this has been reported as feasible by an International Commission. The commissioners advised the examinations of the three following routes, by the St. Lawrence River to Montreal, by the St. Lawrence River, Lake Champlain and the Hudson River to New York, and by Lake Ontario, Lake Oneida and the Hudson River to New York. The St. Lawrence route would prove very much the cheapest, but this enterprise is never likely to be undertaken as an international work, because the great bulk of the traffic of the Western States is now with New York and Boston and their surrounding cities, and not with Europe. The Lake Oneida route will therefore best serve their trade, and as this is a purely American route, that would not in any way tend to the building up of Canadian shipping, and to the increase of an independent Canadian commerce, Canada has no interests in it; while the St. Lawrence route by not leading directly to the Eastern States would not be a benefit to the larger portion of the American trade and would not be considered by the United States.

The proposition that was made to the Dominion Government during the last session of Parliament for the building of a 14 foot canal via the old route of Champlain and the fur traders from the Ottawa River to the Georgian Bay, renders possible the construction of this work at an early date, but it is doubtful if the offer will be accepted by the Government. Considered as a canal it could not under present conditions be made a paying investment as our Government canals are at present operated at a heavy annual loss to the country, but the enormous water power that would be made available by the construction of the proposed system of locks and dams on the Ottawa and on the French Rivers is a commercial prize well worthy of attention. This is estimated at a million h.p., after making all allowances

ior losses in development, an amount that can only be realized by remembering that it is more than twelve times the horse-power of all the engines in Montreal. The Montreal Board of Trade has opposed this proposition on the ground that a route of such importance should not be alienated to a private company; but in view of the history of Canadian transportation affairs it is doubtful whether this ground is sound, even though the scheme itself may not call for commendation. It is certain that our heavily subsidized railroad corporations have shown an energy and enterprise in developing our trade, and in operating their systems to the satisfaction of our shippers, and of the travelling public that we would never expect from a Government work, and have carried on their extensions with a financial success that the Intercolonial has never had. In Mr. Keefer's essay of 1850, that has been already quoted, he remarks bitterly that the subject of canal development is subordinated to the wrangling of rival lawyers; and from the present result of Governmental control in Montreal harbor, and the recent refusal of the Canal Department to make their repairs so as to get the canals ready to be opened at the date the forwarders requested, it would appear as if our politicians had not greatly advanced in states-



manship since 1850, and that for the present, the interests of the country are better served by highly privileged and subsidized companies, whose very existence depends upon their developing our natural resources, than by Government action under the control of party politicians, who cannot afford to exercise any foresight, but must fight day by day to maintain their hold on the narrow majorities on which their tenure of office depends.

MANUAL TRAINING IN PUBLIC SCHOOLS.

The system of manual training about to be introduced experimentally into the public schools of Canada by the Dominion Government, through the generous endowment given by Sir Wm. McDonald, is almost the same as that in use in some of the English schools, and is described by Jas. W. Robertson in a pamphlet recently issued.

The system of education is called English Sloyd. Sloyd is a Swedish word for "dexterity." Educational Sloyd is an entirely different thing from carpentry. The manual training room is not a workshop where operations are carried on with a view to the commercial value of the articles turned out. A workshop is a money-making institution, whereas a room for manual training for Sloyd work—in connection with a school, is for the training and developing of the children, without regard to the intrinsic value of the work turned out, or to the length of time required to make any particular object. Sloyd work is really a series of exercises so arranged as to have educational results.

A floor area of about six hundred square feet is enough to accommodate about thirty pupils and one bench for each. A room 24 x 30 feet would be amply large; and would provide also for the instructor's bench, and for a group of pupils to watch what he was doing. Ten classes of thirty pupils each, or three hundred in all, could be passed through such a room in the week. The benches are of convenient height and size, and each one is fitted with a rack for the holding of tools and also with tools. Some of them are also fitted with a simple device for the holding of the drawings, so that the work with the tools may proceed with the drawing in full view all the time. General class instruction with the aid of a blackboard is given by some teachers in a fifteen minutes' talk, before the particular work of the half-day begins; and instruction is given also to each of the pupils individually as the work at the benches proceeds.

In some schools the first object to be made is a plant label. This involves (1) cutting to an exact length, (2) cutting the ends square by the use of a fine saw, (3) reducing to the proper thickness and width, and (4) making a taper with the same angles as those of the model. In other schools a small pointer is the first model; and in others some object equally easily made. The first article is easily made; the second introduces some slightly different use of a tool or the use of some different tool; and so they proceed, arousing, training and gratifying the child as he makes all of each one himself. It is to be remembered that the pupil makes each article wholly himself. At first he makes directly from the models. Later on he makes drawings from drawings of the models. Further on he makes his own drawings directly from the models. Then finally he is trained to make the articles from his drawings of the models. The course may be arranged on a plan of from thirty to sixty or more articles to be made by the pupil during the three years.

The lectures of Otto Salomon, the renowned director of the Seminarium for teachers at Naas, Sweden, furnished valuable suggestions on the choice of models and on the arrangement of the series of models. An authorized edition of those lectures is published under the name of "The Theory of Educational Sloyd." From it the general principles relating to the series of models are given: (1) All objects of luxury—knick-knacks—should be excluded. From an educational point of view, we must first teach what is necessary; secondly, what is useful; thirdly, if time permits, what is agreeable. These terms are, however, relative.

What is necessary to one person may be useful to another, and what may be useful to one, agreeable to another. What is a luxury in one age or country, is not necessarily so at another time or place. What is a luxury to a poor man may be a necessity to a rich. In regard to nature the terms are more absolute. What is necessary to one is necessary to all. It is necessary to eat food; it is useful to eat food sufficient, and of good quality; it is agreeable to have it well cooked and prepared.

(2) All models should be serviceable in the house. If this is to be the case, the models will vary to some extent in different schools. Not only will the models be different in different countries, but in different districts of the same country; e.g., in country schools it would not be wise to teach the manufacture of objects only useful in towns. It would be preferable to substitute models which may be used in agriculture; but in substituting other models, care must be taken not to disarrange a carefully graduated series of exercises. So, too, if the school be near a lake, objects concerning boats and fishing should receive attention. The general principle by which we should be guided is: That the series of models made in the school should give the best expression to objects needed at home or in the district.

(3) They should be capable of being finished by the children without help. Hence models should not be a part merely of something, but the whole. For this reason it has been found necessary to exclude many things which would otherwise have made useful models.

(4) The models should be of wood, and only wood should be worked in, as a rule. To this rule there are one or two exceptions, as the cloak suspender, the clothes rack, and bucket; and these have been inserted because teachers in the country districts of Sweden cannot buy them, but there is no reason why they should be retained in an English series. When it is said that the models must be made of wood, it is not implied that there is any objection to the purchase of iron fittings.

(5) The objects should not be polished or stained. In the first place, because children cannot polish well. Models are frequently spoiled by it. Many juniors cannot polish well, i.e., French polish. In the second place, it is important that children should not be taught to think too much of the surface. It is not so important that a thing look well, as that it be done well. Polishing and wood carving exert a morally bad influence, if done to cover up bad or indifferent work. It is a degradation of

the polisher's and carver's arts to use them for such a purpose.

(6) The objects made should be such as to require as little wood as possible. Some models require much wood, but if the same exercises can be furnished by smaller objects equally useful, then these should be preferred. The value of the object must be in the child's work, and not in the amount of material used. This recommendation has a further value, inasmuch as it teaches the child to use small means in effecting ends. Children should be trained to be economical by taking care of those pieces of wood for smaller objects which they have spoiled in making larger ones.

(7) The children should be taught to work in harder and softer kinds of wood—but not in the hardest or the softest. (8) Turnery and carving should be used very little. (9) Objects chosen should be such as will develop the sense of form. (10) All the exercises (embraced by the particular kind of Sloyd in question) which the child is capable of making, should be properly graduated and included in the series in due proportions.

(1) The series should proceed from the easier to the more difficult, and from the simpler to the more complex; which expressions, as we have seen, are not identical in meaning. (2) A refreshing variety must be afforded. (3) In the early part of the series, the models should be capable of being quickly and easily made, and should be so progressively arranged that, later on, the objects arrived at should require more time and skill, and yet be capable of being done without help. Children expect to have results as quickly as possible. They have not sufficient patience and foresight to derive any benefit or satisfaction from results which are expected to crown their labors in a few days or months. For this reason the objects further on in the series should take more time, in order to cultivate patience and foresight. (4) In the production of the early models, few tools should be required, but as the series progress, new tools and manipulations should be introduced. (5) That every model should be so placed in the series, that the necessary qualifications for doing it exactly are found in the child, who therefore does not need the help of the teacher. It should not relatively be more difficult for a child to do one model than another. A model may be more complex, but this does not imply an increase of difficulty; for the child—when it reaches it—has acquired greater skill. A person who has used one tool will use a second better, although it be of another kind; he will use a centre bit better for having previously worked with a knife. (6) The models must be so arranged that the pupils can always make not only a serviceable, but an exact copy. The degree of exactness is a very important feature. It is easy to make a table if exactness be not required. (7) That the knife—as the fundamental tool—be used frequently especially at the beginning. By the fundamental tool, we understand that tool with which the child is most acquainted and can most easily use, hence we begin with it; secondly, that tool which cultivates the greatest amount of manual dexterity; and thirdly, the tool which in after life will be most useful to the child, and most ready to hand. These advantages the Sloyd knife possesses. We must not be understood to imply that this tool is the one most used throughout the series of models. (8) That generally in the early models the softest wood should not be used. It is more difficult to use a knife on a very soft wood than on a wood not so soft; so that it is advisable to avoid using the softest kinds of pine and fir.

THE PRACTICAL MAN.

IRON AND STEEL.

The following is from Fowler's Mechanical Engineer's Pocket Book for 1900, which contains some five hundred pages of valuable information:

1. Pig Iron.—Impure iron containing over 1.5 per cent. of carbon, and large quantities of other impurities always made in the blast furnace. Used for castings, and as the raw material for the production of malleable iron and steel.

2. Malleable or Wrought Iron.—Nearly pure iron. Has not been fused since the removal of the foreign constituents, but has been prepared by the welding together of small masses of spongy iron. It always contains particles of slag and oxide, the elongation of which during rolling produces the fibre. Commercial malleable iron is always made by puddling.

3. Steel.—This includes all varieties of iron containing less than 1.5 of carbon except malleable iron. It may have been fused as in crucible cast steel and mild steel, or it may have been prepared in the solid condition, as in blister steel and puddled steel; the latter is rarely if ever made now. When the steel contains less than .5 per cent. of carbon it is called mild steel, when more, hard steel. Hard steels harden when they are heated to redness and quenched in water.

PIG IRON—CONSTITUENTS AND IMPURITIES.

Pig iron is very impure, containing carbon, silicon, phosphor, sulphur and smaller quantities of other impurities. The carbon and silicon may be considered as being essential constituents. It is always smelted in the blast furnace. The iron ore, which contains oxide of iron and silica, and other earthy impurities, is charged into the furnace with coke and limestone, and air being blown in the coke burns, and a very high temperature is produced. The iron is reduced, and, combining with carbon and other substances present, forms pig iron. As various reducible constituents are always present in the materials, the iron always contains impurities. Carbon is the essential constituent in pig iron, the smallest quantity which will entitle the iron to be called pig iron is 1.5 per cent., and the largest amount the iron can take up—except in presence of large quantities of certain foreign elements—is 4½ per cent. The carbon is present in two forms, (1) in a state of chemical combination, (2) as intermixed flakes of graphite. The graphite has very little effect on the iron, except that it breaks the continuity, and thus weakens the metal. The combined carbon is one of the most important constituents. Its influence is to harden the metal, and, within limits to increase its tensile strength. It may vary in amount from about .08 in a soft No. 1 iron to 1½ or more in a white iron. The graphite is the carbon which is not combined. Silicon.—This constituent is always present in pig iron. Its action resembles that of carbon in many ways, and there seems to be no limit to the amount that can be taken up. Silicon has within limits a good effect on the iron, but when in large quantities makes it hard and brittle. Turner gives the amount of silicon which is best as being:

For maximum hardness, under	.8
For maximum crushing strength, about	.8
For maximum modulus of elasticity, about	1.0
For maximum density in mass, about	1.0
For maximum tensile strength, about	1.8
For maximum softness and working qualities, about	2.5
For lowest combined carbon, under	5.

Silicon has two actions, (1) a direct hardening action similar to that of carbon, only much less energetic, and (2) a tendency to throw the carbon out of the combined, and into the graphite condition, the second action being usually the more important. Thus when an iron contains, say 2.5 per cent. of silicon, this will harden the iron to some extent, but it throws the carbon almost entirely into the graphitic condition, and thus prevents the much greater hardening influence which the carbon would have if combined. Grey pig iron is usually high in silicon, whilst white is low. The amount of silicon depends largely on the temperature at which the iron is made, the higher the temperature the more silicon is reduced, so that modern hot blast irons are higher in silicon than those made years ago, when the air was sent in at a lower temperature. Sulphur is rarely present except in small quantities. It has a powerful hardening effect, tending to throw its carbon into the combined condition. It thus counteracts the action of the silicon, and the lower the silicon the more injurious is a small percentage of sulphur. Phosphorus is always present, the quantity varying from a mere trace up to three or four per cent. Phosphorus increases the fluidity of the metal, makes it run well, and set slowly; in large quantities it makes the iron hard and brittle. Manganese.—This element is almost invariably present. Like silicon it has a direct hardening action, and an indirect softening action, the latter being due to a strong tendency to eliminate sulphur. Aluminum tends to throw its carbon into the graphitic form more energetically than silicon. It also improves the soundness of castings. Hematite or Bessemer Pig. This iron is made from hematite or other pure ores. It must not contain more than about .05 per cent. of phosphorus, and .01 per cent. of sulphur, and is usually high in silicon. It is used for

the manufacture of Bessemer and Siemens steel, and more rarely for foundry work. Scotch Foundry Pig.—This is largely used for foundry work. It contains from .7 to 1.1 per cent. of phosphorus and about 2.5 per cent. of silicon. It is an excellent iron for foundry purposes. There are various brands to be had, but as a rule there is but little difference between them, certainly not enough to warrant its great difference in price, the prices seeming to depend more on reputation than on actual composition of the pig.

Staffordshire All Mine Pig.—This is a pig iron made in Staffordshire from ore without the addition of cinder pig. It contains .5 to .75 per cent of phosphorus.

Cinder Pig.—This is made in Staffordshire from tap cinder, it is usually high in phosphorus, and is often blown, i.e., full of cavities.

Cleveland Pig.—This is a pig iron made in the Middlesborough district from Cleveland ore. It usually contains about 1 per cent. of phosphorus and 2.5 per cent. of silicon.

Basic Pig.—This is a pig iron made specially for the manufacture of basic steel. It contains 1 per cent. or less of silicon, and from 1 to 3 per cent. of phosphorus.

Cold Blast Pig.—Is iron made in furnaces supplied with a cold blast; it is usually low in silicon.

Charcoal Pig—Is pig iron made in furnaces in which charcoal is used as a fuel. It is now rarely made.

Silicon Iron, or Siliconeisen—Is a pig iron containing 10 per cent. or more of silicon. It is made for special purposes, or occasionally by accident, which is usually called glazed iron. It is white in color, hard and brittle.

Spiegeleisen—Is an alloy of iron and manganese, containing 20 per cent. or so of manganese. It breaks with a fracture showing large mirror-like crystalline pieces, with a high metallic lustre—whence its name.

Ferro-Manganese—Is an alloy of manganese and iron, often containing over 80 per cent. of manganese. It breaks with a granular fracture of a bronze white color. Spiegeleisen and ferro-manganese are used in the manufacture of mild steel.

Chrome Iron—Is an alloy of chromium and iron.

Ferro-Aluminum—Is an alloy of iron and aluminum

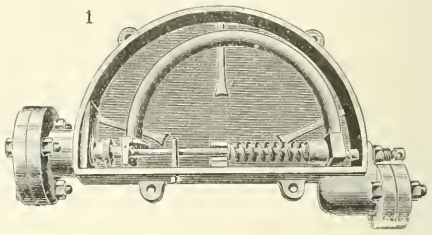
GRADING PIG IRON.

Pig iron is classified into a series of grades, usually 1, 2, 3, 4, mottled white, though the classification varies in different districts. No. 1 is always the grayest iron, and the last, whether indicated by a number or a name, is white. No. 1 is the grayest iron, the fracture is largely crystalline, flakes of graphite being distinctly seen. It is soft and has a low tensile strength, but flows readily when cast. It is usually high in silicon, high in graphites and carbon, but low in combined carbon (about .15 per cent.). No. 2 is similar to No. 1, but the crystallization is less distinct; it is stronger and harder than No. 1, and contains more combined carbon. No. 3 is still closer in grain, and the crystals of graphite are small and hardly discernible It is stronger and harder than No. 2, and contains usually less silicon and more combined carbon than the lower numbers. No. 4 is very close in grain, and breaks with a dark gray, granular fracture. It is harder and stronger than the lower numbers, but does not flow so freely when melted. It is often subdivided into two. No. 4 (foundry) is, with Nos. 1, 2 and 3, useful for foundry purposes, and No. 4 (forge) is too close and hard, and is only used for the preparation of malleable iron by puddling. White Iron—Is very hard and brittle, and has a low tensile but high crushing strength The silicon is usually low, sulphur often high; the fracture is smooth, almost silver white, and shows no graphite, the carbon being almost all in the combined form Mottled Iron This consists of matrix of white iron, with spots of a close grained gray iron scattered through it It is therefore intermediate between white iron and No. 4 No. 4 forge—mottled and white—irons are only used for conversion into malleable iron.

The grade is judged entirely by the appearance of the fracture and the system of grading is most unreliable and unsatisfactory, and there is no standard by which a grade can be judged One of the great needs in the iron trade is a better system of grading The only system which has been suggested is based on the percentage of combined carbon, but as this could only be determined by analysis, it is not likely to displace the present rough and ready system

A STEAM TRAP.

One of the most interesting exhibits at the recent Export Exhibition in Philadelphia was that of the Heintz Steam Saver, the Canadian agents for which are the James Morrison Brass Mnfg. Company, 89 Adelaide street west, Toronto. The device was shown in many forms and applications, and for the purpose of better observation, the pipes leading to and from such traps as were in actual service had sections of gauge glass inserted, so that an ocular demonstration was possible, that proved exceedingly interesting to many steam users who had occasion to study economy as well as efficiency. The great development that has taken place in the past five years of the Heintz plants was a topic of much comment amongst people familiar with it. When the inventor, M. Heintz, of Liege, Belgium, first began business in 1874 he was his own workman, salesman, bookkeeper and engineer, and it was several years before he had advanced sufficiently with his efforts to justify his employing an assistant. The development was remarkably rapid from that on, and to-day his plant forms one of the most striking in a locality that abounds in large industries. He employs some six hundred people in this one factory alone, and has others in France and the United



States. To-day the American sales are said to be enormous. The field of usefulness for the Heintz traps is proportionately greater in Canada than in the United States, for the reason that the necessity is greater owing to the severer winters and long continued cold weather; and it is not unreasonable to look for a larger business for this article in the near future. The Canadian agents make a most favorable showing to prospective customers, and it would seem as if, from the nature of it, no steam user could afford to ignore it. It is at least possible under their proposition to ascertain definitely whether or not a steam plant is as well equipped as it is capable of being, without this experiment or trial costing the user any money, if it proved to be unsuccessful, and it would seem as though an offer of this character would appeal to every user of steam.

The inventor claims (and his claims are said to be substantiated by users), that the adoption of his device will save from 10 to 50 per cent. in fuel, and at the same time increase the efficiency of the apparatus trapped, from 10 to 40 per cent.

It is a singular fact that the Heintz trap or Steam Saver enjoys no patent right protection. Anyone who thinks he is capable of doing so, is at liberty to make them, and in the past twenty years, something like fifty or sixty companies have been organized for the purpose of making the effort. That these companies all failed, one after another, speaks volumes for the acumen displayed by Mr Heintz in not taking out patents for his perfected apparatus; the reason he gave at the time being that as it required seven years constant effort on his part to discover how to make the Heintz trap, he did not believe it was possible for any one else to find out any more quickly than he did.

—The B. F Sturtevant Co., of Boston, Mass., reports an increase of nearly 40 per cent in the volume of its business for 1899 over that of the previous year The shipments, both foreign and domestic, included fan blowers for all purposes, heating, ventilating, drying and mechanical draft apparatus, engines, electrical apparatus, etc. During the past year an addition, covering 20,000 square feet, has been made for the use of the electrical department, which has shown the most rapid growth, the output having more than doubled during the year, and covering principally electric fans and special generating sets The sale of mechanical draft apparatus has been practically quadrupled, while the output of engines has increased one third over that of the preceding year, and has included many special designs.

COMBUSTION.

C.A.S.E. Executive Office,
Lesson Paper No. 4.

Heat and motion are so intimately connected together that you cannot have one without the other. Any body of matter that is absolutely still would be at absolute zero, or 461° below zero on Fahrenheit's scale. Tyndall tells us that heat is motion; and by combustion we mean the combination of chemical elements commonly called burning. All matter or any body of any material is either an element, a compound or a mixture. Iron, gold, silver and oxygen are elements; wood, water and carbonic acid are compounds. Any substance that can be decomposed or divided into other substances is called a compound. Lime may be divided into two other substances, calcium and oxygen, and is a compound. There are many substances that cannot by any known process be subdivided into other substances, such as gold, sulphur, iron and arsenic; this being the case they are called elements. The elements we will consider are hydrogen, and its symbol is H; oxygen, O; nitrogen, N; carbon, C; sulphur, S. In referring to these elements the symbol is the first letter of its name; as C for carbon, etc. When two or more elements are brought together under favorable circumstances, they will combine and form a new substance entirely different from either of the elements.

Hydrogen is a very light gas and burns with a steady blue flame, and it burns because of a chemical combination with the oxygen of the air, and the product of this combination is water. Just as chemical combination produces heat, so will chemical separation absorb heat. If carbon and oxygen are brought together at a high temperature they form carbon dioxide; hydrogen and oxygen form water; hydrogen, nitrogen and oxygen when combined under certain proportions form nitric acid. Ammonia is formed by a combination of nitrogen and hydrogen, and is a very different gas from either of its components. In making these combinations a certain amount of heat is produced, and if these elements are separated they will absorb exactly the same amount of heat produced by their combination. It is supposed by chemists that equal volumes of all gases, whether simple as elements or compounded, contain the same number of molecules, and that each molecule is composed of two atoms. Suppose that hydrogen and oxygen are in contact with each other and are heated, they will combine and form steam or water. It will be found that two atoms of hydrogen will be seized by one atom of oxygen to form one molecule of water, therefore the volume of hydrogen must be double that of the oxygen. Hence we have for a symbol H_2O, that is two parts of hydrogen to one of oxygen. Hydrogen and carbon also form a compound, each atom of carbon seizes four atoms of hydrogen and forms a molecule of marsh gas, the symbol for which is CH_4.

Mixtures may be formed of two or more elements that may be mixed together, but will not combine to form a new substance. The ordinary atmospheric air is an example. It is composed of oxygen and nitrogen; 23 parts by weight of O to 77 parts of N; these two gases are not chemically combined, they are only mixed. Combustion is only a very rapid chemical combination, in which the oxygen of the air combines with the carbon in the fuel. Oxygen has an attraction for nearly all the elements, but more especially for carbon, and when they meet at their igniting temperature they combine with great rapidity, and make a roaring fire, and give out a great quantity of heat, as in a boiler furnace.

The elements that enter into combustion are carbon, oxygen and hydrogen. When carbon and oxygen combine they form CO_2, or carbon dioxide, and when oxygen and hydrogen combine they form water, H_2O. These are the products of combustion.

In our furnaces we take the oxygen from the air, and the nitrogen passes through the fire with it, but takes no part in the combustion. Now CO_2 or carbon dioxide is composed of 12 parts by weight of carbon to 32 of oxygen. Hence to burn a pound of carbon requires $32 \div 12 = 2\ 2\text{-}3$ lbs. of oxygen, but it will take 11.6 lbs. of air to supply the $2\ 2\text{-}3$ lbs. of oxygen, because only 23 per cent. of the air is oxygen; 1 lb. of carbon, if combustion is complete, will give 14,580 B T U., and the product is CO_2, or carbon dioxide; but if carbon oxide, CO, is the product the result is only 4,451 B T U. At the commencement of combustion 1 lb. of carbon (C) unites with 2.66 lbs. of oxygen, and forms 3.66 lbs. of carbon dioxide, setting free 14,580 heat units. The volume of the CO_2 is the same as that of the air from which it was formed, but its density is greater and the combustion is complete; but if the air is wanting in quantity the 3.66 lbs. of CO_2 absorbs 1 lb. of carbon, making 4.66 lbs. of carbonic oxide, CO, or marsh gas, and the heat set free by these 2 lbs. of carbon is 8,902.8 heat units, or 4,451.4 per lb. of carbon. The combustion of a lb. of carbon to make (CO) only requires ½ the quantity of oxygen that is necessary to form (CO_2), because in the gas (CO) one atom of carbon seizes only one atom of oxygen instead of two. To burn 1 lb. of carbon to carbon dioxide (CO_2), requires 11.6 lbs. of air, while to burn it to carbon oxide (CO) would only require 5.8 lbs. of air. The quantities of air required for combustion of fuel can be seen from the following table:

1 lb.	Air at 62°	Product.
Hydrogen	34.8 lbs. or 457 cu. ft.	Water, nitrogen.
Carbon burned to CO_2	11.6 lbs. or 152 cu. ft.	Carbon dioxide, nitrogen.
Carbon burned to CO	5.8 lbs. or 76 cu. ft.	Carbon monoxide, nitrogen.

The air required for the combustion of a pound of fuel is easily determined if you know the percentages of carbon and hydrogen it contains. Example: Your coal contains 90 per cent. carbon, and 10 per cent. hydrogen; now to burn the carbon you would need $152 \times 90 \div 100 = 136.8$ cu. ft. of air, and for the hydrogen, $457 \times 10 \div 100 = 45.7$, $45.7 + 136.8 = 182.5$ cu. ft. of air.

Rule to find the air required to burn a given fuel: To the carbon in the fuel add three times the hydrogen, multiply the sum by 1.52, and the result will be the cubic feet of air required. Example: Composition of coal being carbon, 84; hydrogen, 5; oxygen, 7; ash, 4; to perfectly burn 1 lb. of such a fuel by the above rule: Ans.$= 1.52 \times (C + 3H) = 1.52 \times (84 + 3 \times 5) = 150.8$ cubic feet.

The quantities of heat produced by complete combustion of the elements composing fuels are for

Hydrogen—62,000 B T U per lb.
Carbon to CO_2—14,580 B T U per lb.
Carbon to CO—4,400 B T U per lb.

The chief consideration for economical combustion is the correct air supply. It is not possible to attain perfect combustion with the theoretical amount of air, which is 11.6 or 150 cubic feet per lb. of coal, because in the conditions obtained in our furnaces we cannot get the air into perfect contact with the burning carbon of the coal, for this reason we have to supply about double the quantity of air or 24 lbs. If more air than is actually needed is allowed into the furnace it simply carries heat from the furnace to the chimney, while if too little is used we get marsh gas instead of carbon dioxide. If it were possible to heat the air during the short time it is going through the fuel up to the heat of the fuel the theoretical amount would be all we would require for perfect combustion; one of our losses in the furnace is the driving off by the heat of the hydrocarbons contained in all our bituminous coals, before these coals really begin to burn. These gases are driven off, and are very likely to escape unburned up the chimney. The admission of a small quantity of air above the fire will sometimes burn them. If they are not burned they escape as black smoke.

The best smoke burner in the world is a fireman that knows how to handle his fires in well set boilers with ample draft.

A. M. Wickens, Secretary.

—The new addition to the works of the B. F. Sturtevant Co., Boston, Mass., which was designed to meet the requirements of its rapidly growing electrical department, is already overcrowded, although completed only a few months ago. Numerous special orders for electric fans and generating sets for the U. S. navy are being filled, and the construction of a complete line of enclosed motors of new design is now under way.

RAILWAY BUILDING IN MANITOBA.

Manitoba has seen a considerable extension of its railway lines during the past year. Construction was carried on upon thirteen lines, of which twelve were in Manitoba, and one in Northwestern Ontario. In the territories west of Manitoba no new railway building has been done, except the Pipestone branch of the Canadian Pacific Railway, which was built across the Manitoba boundary and on westward some miles into Assiniboia territory. The southern half of the province of Manitoba is fast becoming a network of railways, says The Winnipeg Commercial in a recent issue. The new mileage for the year was 351 miles. The province of Manitoba has 2,000 miles of railway. During the past year the C.P.R. Co. has carried on new railway construction at points within Manitoba, including the extension of the Northwest Central and the short link connecting the latter railway with the Rapid City branch of the Manitoba and Northwestern. These two roads are both now controlled by the Canadian Pacific Railway Company. Two new branches in Southern Manitoba, known as the Snowflake and Wascada branches, respectively, are short feeders to the Deloraine branch, affording better railway facilities to well settled agricultural districts south of the Deloraine branch. These two new branches have been completed and are now being operated. The Snowflake branch has a total length of a little over 17 miles, and the Wascada branch, which starts at Deloraine, is something over 18 miles long. A little north from Deloraine we have the Pipestone branch, where a considerable amount of work has been done. An extension of 17 miles was graded on this branch during the summer of 1898, westward from Reston. This 17 miles was completed during the past year, and an additional 23 miles has been graded, and is now mostly ironed, making 40 miles of new road added to the Pipestone branch during the year. This branch is giving much needed railway facilities to a fairly well settled agricultural section. About fifteen miles of the new portion of the Pipestone branch, west of Reston, is in Manitoba and the balance of 25 miles is in Assiniboia territory. The C.P.R. has extended the Northwest Central 22 miles west of the former terminus at Hamiota, and the extension is fully completed and in operation. A town called Miniota has quickly grown up at the new terminus of the line. A three-mile link has been built at Rapid City, between the Northwest Central and the Manitoba and Northwestern Railway. The McGregor-Varcoe branch of the C.P.R. will be about 48 miles long and one-half was graded this season. The Lac du Bonnet branch will run 22 miles from Molson Station on the C.P.R. to Lac du Bonnet. Ten miles are now under construction, and will be completed before spring.

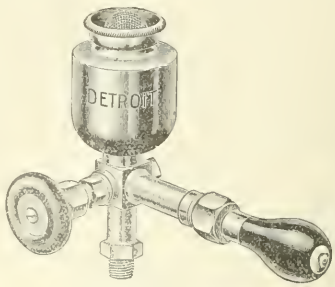
The Northern Pacific Railway has constructed about 30 miles of new railway in Manitoba during the past year. This consists of a new branch, extending in a northerly direction from the town of Portage la Prairie, a distance of nine miles, toward Lake Manitoba, and also an extension of the Portage la Prairie branch in a northwesterly direction, from Portage la Prairie, a distance of 20 miles. The new branch extending toward Lake Manitoba will be known as the Lake branch. The terminal of this branch has been named Oakland. The road runs through a fine wheat country.

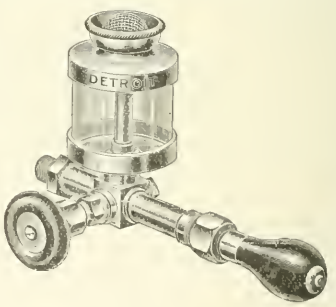
The first section of the Manitoba Southeastern was built in 1898, extending from St. Boniface to Marchand, a distance of 46 miles. The work was taken up again last spring and is still being pushed. Over 50 miles have been completed, and it is the intention to continue the work until the road is ironed to War Road, in Minnesota, making in all an addition of about 68 miles for this season's operation.

The Canada Northern Railway has continued operations as was expected during the past year. During 1898 this new road was extended in a northerly direction from Sifton to Cowan, a distance of 56 miles. During 1899 a further extension of about 65 miles has been made, from Cowan to a point about 11 miles beyond Birch River. Leaving Cowan, the new line runs in a westerly direction about 30 miles to Swan River, and then turns north again, passing to the east of Porcupine mountain. This road is opening up an entirely new country, in the northern part of Manitoba, which is well adapted to mixed farming and stockraising. There are also large and valuable timber areas which will thus be opened up. The length of the main line of the Canadian Northern, with the addition now about completed, is 240 miles. Construction was begun during the past year on a new branch, running about due westward from the town of Dauphin. This road is known as the Gilbert Plains branch. Work is going on on this branch still, the object being to complete 15 miles at once, and a further extension of probably about 20 miles will be made during 1900.

INTERCHANGEABLE OIL PUMPS.

The accompanying cuts show the new style oil pumps that have recently been put upon the market by the Detroit Lubricator Co., Detroit, Mich. An advantage claimed for them, over the ordinary styles, is that the body can be easily removed from the frame should it be desirable to do so for the purpose of removing any dirt or sediment deposited by the oil, without removing the oil pump proper from the steam pipe. Each style is made with both vertical and horizontal connection shanks, and the bodies of the whole four styles, of the same sizes, are interchangeable. For instance, the body of the brass body oil pump with vertical connecting shank can be interchanged with the glass body of the pump shown with horizontal shank, etc. Each style is also equipped with strainer filler. The manufacturers have issued a pamphlet showing these oil pumps, also their new style glass and brass oilers, and will send same to any address on application.





—By Order-in-Council, passed January 18th, the Ontario Government has prohibited the export of pulpwood cut on Crown lands after May 1st. This is a step in the direction of home manufacturing which has been urged so often in The Canadian Engineer.

—An ingenious arrangement to prevent overcrowding of stairways and elevators when entering or leaving a building is used in the main office of the International Correspondence Schools, Scranton, Pa. The time of entering and leaving the building is regulated by clocks on each of the five floors. On the lower floors the clocks are set correctly, but on the upper floors they are a few minutes slow, so that the employees on the lower floors are at their desks before those on the upper floors are due at the building. In leaving the building the employees on the upper floors do not leave their desks until several minutes later than those on the lower floors. Over 500 people are employed in the building, which is used exclusively by the International Correspondence Schools. This institution has over 70 courses of instruction by mail, and its students may be found in all parts of the world

OILSTONES, HOW TO SELECT AND USE THEM

If the iron be blunt and he do not whet the edge, then must he put to more strength.—Ecclesiastes x., 10.

No article in a mechanic's kit of tools is of greater importance than the oilstone, for no matter how good the quality of his edge tools, they cannot do good work unless properly sharpened. If it were possible to show in figures the total loss in damaged tools and wasted time resulting every year from the use of poor and unsuitable oilstones, the sum would be amazing—far exceeding, doubtless, the total amount of oilstones sold. Notwithstanding this fact, very few mechanics and still fewer tool dealers understand the particular merits of the different oilstones on the market, or how to select them for different purposes. The object of this article is to give a few practical suggestions on the selection, use and care of oilstones, in such terms that the amateur as well as the experienced mechanic may obtain a clear understanding of the subject, and benefit thereby.

Far in the past, while man was fighting his way up from his barbaric condition to civilization, the sharpening stone was one of his most important tools. Old stone implements and weapons discovered in caves, mounds and excavations in various parts of the world give evidence of this; for among those ancient relics have been found stone arrowheads and crude axes with sharp or ground edges. At first, it is probable that these were ground down by rubbing on large rocks. Later on in man's progress, when it was discovered that metal made better edge tools than stone, the sharpening stone became a still more important factor; more care was taken in selecting the kind of stone for grinding these tools, and instead of rubbing the tools on large boulders, he evidently broke off small pieces of rock and faced them by rubbing together.

Many pieces of hones and whetstones of various kinds have been found in the excavations of Pompeii and other ancient cities. Coming down to the time when the art of transmitting written records had been learned, we find whetstones referred to frequently by the earliest historians. The word "whet," as referring to the sharpening of swords and iron tools and weapons, occurs several times in the Bible, and the historian Pliny, writing over 1800 years ago, tells us that there were many different kinds of stone used in those days for sharpening iron instruments. He states that the best ones came from Crete, and gave better results when used with oil. As the well-known Turkey oilstone is still found in Crete, although quarried principally in Asia Minor, it is probable that this is the stone Pliny refers to, which would indicate that the Turkey stone has been in use for nearly two thousand years. It was the principal oilstone of the civilized world until the discovery of Arkansas and Washita stones in the early part of the present century. These two kinds of stone, which are the same geological formation, but vary in hardness and fineness, were discovered in the Ozark Mountains of the state of Arkansas, U. S., somewhere about the year 1815, when it was quickly perceived that they were superior to anything ever found for sharpening edge tools. In those days of slow and costly transportation it was very expensive getting the stone into eastern markets, the rough rock bringing as high sometimes as $2 per pound. In spite of this, the remarkable sharpening qualities of these stones rapidly increased the demand for them, until to-day they are the two leading oilstones of the world.

The first point to be considered in selecting an oilstone is the purpose for which it is required; many mechanics make the common mistake of expecting one oilstone to answer all purposes. It would be just as reasonable for a carpenter to use a coarse-tooth crosscut saw on fine cabinet work, as to expect a coarse-grained fast-cutting oilstone to impart a fine razor edge. The sharpening qualities of a stone depend upon the size of its grains of grit, or crystals. In a coarse-grit stone, these grains are large, and cut deep, far apart furrows in the tool, leaving a coarse, rough edge. Such stones cut away steel faster than a fine-grained stone (as a coarse-tooth saw cuts faster than a fine-tooth). The coarse edge left by such a stone is all right for working pine or soft woods in which the cells are large, but for working hardwood or any kind of fine work, the tool should be finished on a finer-grained stone. It is therefore safe to lay down the rule that a good mechanic should have at least two oilstones, one for grinding down dull tools, or imparting a coarse edge, and another for finishing. There are some stones of medium grit which answer well for many purposes, but they cannot cut as rapidly as the coarse stone, nor impart so smooth an edge as the fine. A carefully selected Washita stone is stated to be the best general purpose oilstone. The hardness of an oilstone is also an important factor in determining its cutting qualities. For sharpening ordinary tools with broad blades or edges, a medium-soft, fast-wearing stone should be chosen. For sharpening narrow chisels, engravers' tools or pointed instruments, however, it is necessary to use a very hard stone, as otherwise the stone will soon be cut full of grooves or furrows. The difference between a hard and soft Washita stone can be told in several ways; first, by the sight, as in a soft stone the minute pores are usually apparent to the eye, and the surface of the stone will have an open, granulated appearance; second, by scratching with a knifeblade, as a soft stone can be quite readily scratched on the edges, whereas a hard stone will show very little impression; third, by the sound, holding the stone loosely by one end between the thumb and fore-finger and tapping it with a knife, light hammer or any metal substance; the soft stone will sound dead like wood, whereas a hard stone gives forth a metallic ring. Having decided for what purpose the stone is to be used, the next thing is to find a stone that has the desired qualities. This leads to the consideration of the principal oilstones on the market.

The oilstones most widely in use at the present time are: The Washita, Arkansas, Turkey and Hindostan. Although these stones are well known to most mechanics, a brief description of them may not be out of place. The Washita and Arkansas stones are quarried in the state of Arkansas, near the celebrated Hot Springs. They are found in parallel veins, or "mineral leads," and are quite similar in general appearance, both being white or nearly so, but the Arkansas is very much harder, more compact and finer grained than the Washita. There are various qualities of Arkansas and Washita rock, from a perfect, fast-cutting grit to the vitreous, flinty rock that is practically worthless. To the ordinary observer, the appearance of the good stone and the worthless is so nearly the same that it is always advisable to buy the known brand of a reliable manufacturer. At frequent periods, since these stones first came on the market, inferior qualities have been put out by irresponsible or inexperienced manufacturers, which has done serious injury to their reputation in some localities. For the past few years, however, the output of the best quarries has, it is stated, been controlled by one firm.* As this firm has taken great care to select and manufacture only the best rock, both reputation and demand have rapidly increased.

The Arkansas stone is found in two grades, known as hard and soft. Hard Arkansas is composed of nearly 99½% pure silica (one of the hardest, sharpest cutting minerals), and is about 16 times harder than ordinary marble. Steel will not scratch it, but it, in turn, will cut the hardest steel very rapidly. It is white or bluish white in color, and by reason of its very fine, hard grit, is particularly adapted to sharpening fine tools requiring very keen, smooth edges, such as are used by engravers, watchmakers, diesinkers, wood and ivory carvers, surgeons, etc. Owing to the very limited supply of good Arkansas rock, and to the great difficulty in quarrying and manufacturing it (about 85 per cent. being waste), it is necessarily very high-priced, a first-quality stone being worth $2.50 per pound at retail. A stone of extra large size or special shape is worth even more than this. Soft Arkansas is of the same composition as the hard, but is more porous, hence does not impart quite so fine an edge. It is used very largely by machinists, workers in hard wood, cutlers and mechanics in general as a finishing stone. It is carried in stock by most tool dealers, and generally sells at about one third less price than hard Arkansas.

The Washita oilstone is the most widely used by carpenters and joiners. It has crowded the Turkey stone almost entirely out of America, and is fast superseding it in Europe and other countries. It is composed of nearly pure silica, but is much more porous than the Arkansas stone. It is stated by geologists that a cubic inch of perfectly crystalized Washita stone contains over eight million (8,000,000) cavities, or pores. It is the presence of this vast quantity of evenly distributed pores which enables the grit grains, or crystals (the teeth of the stone) to work freely and thus make it the fastest cutting fine-grained stone.

*The Pike Manufacturing Co. of Pike Station, N.H

There is no oilstone in which greater experience is required to select understandingly than the Washita, for it can be found in all degrees of hardness and fineness. For ordinary carpenters' tools, such as planes, bits, chisels, gouges, etc., a medium-soft, even-grained, fast-cutting Washita should be chosen. The Washita stone is put on the market in several qualities by the Pike Manufacturing Co. The Lily White brand is selected by experts from the very best rock; each stone is tested and labeled, telling whether it is a soft, medium coarse or a hard, medium fine grit. Every Lily White stone, whether of coarse or fine selection, is of uniform grit throughout, free from hard or soft spots, or streaks, and of sharp-cutting grit. The No. 1 quality Washita is a well-finished stone, free from cracks, quartz or noticeable imperfections. It is the most largely used brand on account of its lower price, but as there are both hard and soft stones in this grade, and they are not labeled nor warranted, the stone should be selected by a thoroughly experienced judge. The No. 2 quality Washita is, as its name would imply, a second-quality stone. It usually contains some quartz streaks, "sand holes" or other imperfections. In addition to the above-named grades of Washita stone, there is also a brand known as the Rosy Red, which is very similar in cutting qualities to the Lily White, except that it is generally a little softer and coarser. This stone is streaked with orange or dull red color, which in no way affects the grit, but indicates a soft, porous nature. It is a guaranteed brand, and is well adapted for grinding down dull tools or wherever rapid work is required.

The Turkey oilstone, already mentioned, was the leading oilstone for mechanics' tools for many centuries previous to the discovery of the Washita. It is bluish gray in color, with frequent white spots and streaks. It is composed of about 70 per cent. silica, mingled with 30 per cent. lime, clay and iron. The white spots and lines are calcite, or lime, which wear away quickly, leaving holes and rough cavities in the stone. The stone also frequently comes apart in these lines as soon as it is oil soaked. It is nearly impossible to get a perfect Turkey stone, that is, one which is free from these lime streaks or other imperfections. A good Turkey stone will impart a fine edge, but no finer than a fine-grained Washita, while it does not cut steel so fast. It sells for about the same price as Lily White Washita, but very few Turkey stones are now sold in America. Hindostan, although usually called an oilstone, can be used with water with equally good results. It is a very fine-grained sandstone, and is undoubtedly the best low-priced sharpening stone for mechanics' tools. Its cutting qualities are due to small grains of silica, which are remarkably uniform in size in this stone. It is a fast-cutting stone, but owing to its softness, the powder or grit which is cut from the stone soon forms a mud that clogs the pores and makes it cut more slowly unless the stone is kept free by the plentiful use of water. By using a little oil and leaving this dust on top of the stone a fine surface is given the stone, which produces a very fine edge on the tool. It is a very good stone for imparting a quick medium coarse edge, and is used very largely by amateurs and those who do not have to use an oilstone very often. It is sold in three grades, as follows: Export extra quality, which is the finest grained, hardest Hindostan, white or yellowish white in color; Washita finish quality, which is well finished, grayish white stone; and the No. 1 quality, which is generally a very roughly finished stone and varies in color from a bluish gray to almost a yellow. Hindostan stones generally retail at from 10 to 35 cents apiece, according to size and quality.

In our next issue we will deal with other oilstones, and how to use them, also giving a few remarks about stones made from corundum and emery.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The officers and members of Montreal No. 1, C.A.S.E., met at the residence of J. J. York, mechanical superintendent of the Canada Sugar Refining Company, January 27th, to present him with a handsome silver tea set and tray appropriately engraved. The presentation was made by the treasurer, T. Ryan, with a few well chosen remarks on behalf of the members of the association. Mrs. York was also presented with a bouquet of roses. After thanking his friends for their present to Mrs. York and himself, Mr. York invited all present to supper, and a pleasant evening was spent in songs, etc.

J. M. Williams, chemist for the wholesale drug firm of Winer & Co., gave an address before the Hamilton Branch C.A.S.E. at the monthly meeting, January 16th. The subject was "Boiler Feed Water," and it was skilfully handled, the speaker illustrating his subject as he went, on a blackboard. Mr. Williams divided his subject into several parts, viz., water in the abstract, water as we find it, water for the boiler, and water in the boiler. Under the first head he explained the component parts of water and their chemical relation. Under the second head, the different kinds of water, rain, spring, lake and salt water were dwelt on, and their merits pointed out. The third division, water for the boiler, was dealt with at some length, Mr. Williams stating the condition and quality of water to be used for such purpose. The altered condition of water subjected to heat and the actions of chemicals was also dealt with. Finally, the speaker explained the cause of the formation of scale on a boiler and the various kinds of corrosion that boilers are subjected to.

C.A.S.E., Toronto No. 1, held its regular meeting on Wednesday, January 17th. The attendance was good, and the members had a treat in the way of a paper by E. J. Philip, on "Ice Making and Refrigerating Machinery." The date of the annual "At Home" was fixed, and it will be held in the Confederation Life Building on Wednesday, February 14th.

WE ARE WELL HATED.

Wm. Kennedy, C.E., of Montreal, has returned to Canada after an extensive tour through Great Britain and the Continent. As may be imagined, one so observant as Mr. Kennedy would see a great deal of interest from the standpoint of a civil engineer, as well as from that of a politician. In noticing the development of manufactures on the continent, particularly in countries like Switzerland and Austria, it was curious to observe how a Chinese conservatism can exist side by side with the most revolutionary notions of scientific progress. In the immediate neighborhood of a factory operated by a modern electric plant and equipped with the latest machinery one may see some old mill whose primitive wooden machinery is moved by an ancient undershot or overshot water wheel, or a lumber mill containing wheel pits where saws are still operated partly or wholly by hand. And yet the old mill seems to have a fair hold on life, if not positively thriving in these lands. Mr. Kennedy confirms the reports brought by so many other tourists of the prevailing hatred of Britain throughout Europe, even among those nations who have not so much as a sentimental cause of quarrel with the British people, and whose national liberties, if British power were destroyed, would not be worth a week's purchase. This hatred seems to be born at least partly of ignorance of Great Britain's real position and motives, and of this ignorance there appears to be a colossal stock among otherwise well educated people. A highly educated Swiss gentleman, who could speak several languages, asked Mr. Kennedy with the utmost seriousness, whether there was really any friendly feeling in Canada towards Great Britain. In the course of conversation this gentleman disclosed his real notions concerning this country, which were that Canada was held in subjection to Great Britain by military force, and that Canadians were only awaiting a good opportunity to "shake off the yoke," and that any contributions in men to help the Mother Country in the Boer War were raised by a sort of conscription such as ruled in Germany or France. It is needless to say that the fantastic reports circulated through the Leyds' agencies regarding Britain's relations with South Africa are fully believed by the average European, while it is difficult for any friend of Great Britain to get a hearing among these people.

NEW CATALOGUES.

We have received the catalogue of the Standard Tool Co., Cleveland, O. It contains some 80 pages, devoted to the goods made by this firm, and differs but slightly from catalogues published by the original makers of twist drills in the United States, the main point of distinction being a red label in the shape of a shield which ornaments the top of each page, and other blank spaces.

ONTARIO MINERALS.

The following table presents by quantities and values the statistics of metallic production in Ontario for nine months ending September 30, 1899, and for twelve months ending December 31 in the years 1896 and 1893 respectively, as published in the Report of Bureau of Mines, Vol. VIII, second part:

Metals	1899 (9 mos.)		1896 (12 mos.)		1893 (12 mos.)	
	oz.	$	oz.	$	oz.	$
Gold...	20,210	318,212	7,154	121,848	1,695	32,960
Silver..	98,000	58,800	.....	.....	.....	.....
	lb.		lb.		lb.	
Nickel.	4,608,000	566,633	3,897,000	357,000	3,306,000	454,702
Copper.	4,642,000		3,736,000	130,660	2,862,000	115,200
	tons.		tons.		tons.	
Pig Iron	48,216	693,455	28,302	353,780	.....	.....

No silver was produced in the province in 1893 or 1896. The mines were closed down in 1892, and were not reopened until 1898. The first production of pig iron after an interval of more than thirty years was in 1896, and the first production of gold after almost as long an interval was in 1892. The total value of metallic products in 1893 was $602,862, and in 1896 $963,288. For the nine months of the present year it has been $1,637,100, and if the same rate of production be maintained to the end of the year it will reach $2,200,000. The total value of the metals produced in the province for the twelve months of last year was $1,655,968, made up of $290,919 gold, $51,960 silver, $514,220 nickel, $268,080 copper, and $530,789 pig iron. The revenue from sales and leases of mineral lands has been $147,665 for the nine months of the present year, as compared with $97,762 for the whole of 1898, $40,588 for 1896 and $26,159 for 1893.

"TEMPERATURE."

Editor CANADIAN ENGINEER :

Under the above heading in your January issue the following question is worked out in detail:

"If water is at the temperature of 60° F., how many pounds of it will it take to condense 1 lb. of steam at 5 lbs. pressure, the resultant water to be 110° F. ?"

The answer is given as 20.8 lbs.

The following will show that an error has been made. The water is raised from 60° to 110°, or each pound takes up 50 heat units, and as the total number of heat units to be taken up is 1,073, therefore $\frac{1073}{50} = 21.46$ lbs. water required.

Let x = number of lbs. of water required.
t = initial temperature of water.
t_1 = final temperature of water.
H = heat units in steam.

The loss of heat from the steam = the gain of heat by the water

$$H - (t_1 - 32) = x\,(t_1 - t)$$
$$H - t_1 + 32 = x\,(t_1 - t)$$
$$1151 - 110 + 32 = x\,(100 - 60)$$
$$\therefore\ x = \frac{1073}{50} = 21.46 \text{ lbs.}$$

The error arises in treating one quantity "from 32" and the other from zero, making a difference of fully 3 per cent. This error is commonly made in calculations of the kind.

Toronto, January 24th, 1900. A. WOOD.

AMERICAN STOKER CO. VS. GENERAL ENGINEERING CO.

In our October issue a short history was given of the case of the General Engineering Co., of Ontario, Ltd., vs. the American Stoker Co. and the Dominion Cotton Mills Co., of Montreal. The original action, the reader may remember, was brought to recover damages for the infringement of the patents held by the General Engineering Co. on the Jones Underfeed Stoker, and to restrain the defendants from using or erecting these stokers in Canada. The action was carried by the defendant companies from one court to another, till it reached the Exchequer Court, to which it had been taken when our last report was given. The Exchequer Court had given a strong judgment in favor of the General Engineering Co., granting the injunction asked for and restraining the defendants from setting up or using any of the Jones Underfeed Stokers in Canada, with damages. This judgment confirmed the rights of the General Engineering Co. to the Jones' patents, which the American Stoker Co. was adjudged to have infringed. A new point was now raised for the first time, we understand, in connection with the Canadian patent law, and that was the contention by the American Stoker Co. that the Jones patent became invalid in Canada by reason of the expiry of the British and Italian patents for the same invention. In a judgment handed down last month the court held that the American Stoker Co. were not entitled to a writ of *scire facias* for the repeal of the patent in question on this ground. The judgment, however, did not go into the merits of one of the questions raised "as to whether the Canadian patent referred to means a patent issued here after the foreign patent has been issued, or if it means a Canadian patent applied for after the foreign patent has issued. The identity of the Canadian and Italian patents was disputed, but was not dealt with by His Lordship, neither was the question of whether the expiration of a foreign patent by forfeiture before its potential term expired would operate as a termination of the Canadian patent." The court gave permission to the defendants to test these points in a new trial, but the evidence in such new trial would have to be limited to these points, and would not affect the judgment previously given in favor of the General Engineering Co. The American Stoker Co. is thus prohibited from doing business in Canada in the meantime, and should the new trial sought for be pushed and decided in its favor the General Engineering Co. has other subsequent patents on the Jones Stoker as improved, and which patents would not be affected by any decision on the point here raised.

MARKETS OF CANADIAN GOODS IN GREAT BRITAIN.

Harrison Watson, curator of the Canadian section of the Imperial Institute, London, England, is in receipt of the following enquiries: A Liverpool house desires to hear from Canadian manufacturers of wood blocks for mangle rollers for which they could place several orders. An importing house possessing a connection with picture frame makers asks for names of Canadian manufacturers who can supply oak mouldings. A Midlands firm of manufacturers wishes to hear from Canadian importers of elastic boot webs, boot looping, garter webs, skirt bindings, ladies' belts, etc. The manufacturers of a patent metal seek a Canadian resident agent of good standing. A London dealer in high-grade goods would like to hear from Canadian packers of smoked salmon in thin slices, in oil, in tins. A Glasgow importer would like to hear from Canadian manufacturers of cheap bedroom furniture. A Bristol house is open to import ash hay-forks and hickory pick-handles. A Glasgow firm of merchants possessing a connection with the confectionery and wholesale grocery trade seeks agencies of Canadian products. They also have a house in China and are open to consider agencies for the far east. A Paris, France, commission agent asks for samples and prices of Canadian wood bicycle rims for which he has an opening.

FIRES OF THE MONTH.

Jan. 11th, J. I. Lloyd's foundry and machine shop, Kentville, N.S.; loss, $15,000; now rebuilding.——Jan. 15th. R. S. Porteous, Stratford, Ont., furniture factory; loss, about $5,000. ——Jan. 20th. Cox & Johnson's box factory, Vancouver; loss about $3,000.——Jan. 25th. S. Bicknell's cheese box factory, Peterborough; loss, about $3,000.——Jan. 30th. F. W. Shaw's pork packing house, Forest, Ont.; loss, $7,300.——Jan. 31st. Drying house of the Empire Tobacco Co., Granby, Que.

HEIRS WANTED.

Editor CANADIAN ENGINEER :

Sir.—I am looking for the heirs of Braddock Nyle, who is supposed to have lived in Montreal in 1844. Any information will be received with thanks.

Box 523, Houston, Texas. HENRY MALMGREN

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The fourteenth annual meeting of the Canadian Society of Civil Engineers opened in the society's rooms, Montreal, on the 31st inst., the president, W. T. Jennings, in the chair. There was a large attendance of members.

The various committees presented their reports, and all the regular business of the convention was concluded on this day, except the reports of the scrutineers on the election of members of the council. The elections for the chief offices resulted as follows: President, Prof. H. T. Bovey; vice-president, C. H. Duggan, Percival W. St. George and E. H. Keating; treasurer, H. Irwin; secretary, C. H. McLeod; librarian, E. Rhys-Roberts. It was agreed that the report on the election of the members of council should be presented at a meeting to be held on the 8th February.

The following were elected as nominating committee for the ensuing year: For Quebec—L. G. Papineau, C. le B. Leprohon. For Ontario—C. H. Rust, J. Galbraith, G. A. Mountain. For Manitoba and N.W.T.—Col. H. N. Ruttan. For Maritime Provinces—Dr. Martin Murphy. For Newfoundland and Foreign—L. Skaife. On motion of W. J. Sproule, seconded by L. S. Pariseau, Duncan Macpherson and T. Harry Jones, it was decided to devote $200 to the Patriotic Fund. The resolution was followed by "God Save the Queen."

The meeting adjourned at 6.30 p.m., and the members took a special train for Boston, the train being provided by courtesy of the Grand Trunk Railway. A report of the meeting and an account of the excursion and dinner at Boston will appear in next issue.

SCHOOL HEATING AND VENTILATING.

The question of heating and ventilating school buildings is a most important one in Canada, owing to the length of our "closed-in" season. The various systems now in use were criticized in The Canadian Engineer some months ago, when the report of the Toronto Board of Health on the subject of school ventilation was dealt with. The chief engineer to the Board of Education of Boston, Mass., T. J. Waters, in a report on school ventilation in Boston, made to F. W. Chandler, professor of architecture, Massachusetts Institute of Technology, takes up the following, the chief points of which were printed in the City Record, Vol. III., No. 1, which is an official publication of the city of Boston:

(1) It has been my practice to install furnaces in all buildings containing six rooms and under, although I have placed low pressure gravity steam-heating apparatus in some buildings containing but four class-rooms. The small buildings in which furnaces are installed are of a temporary character, and constructed of wood in the outlying districts. (2) The cost of heating and ventilating apparatus of two school buildings, each containing eight class-rooms, and an assembly hall, the equivalent of two class-rooms, erected in 1894, is as follows:

Steam heating and mechanical ventilating apparatus.... $5,188
Furnace heat and natural ventilation..... 3,200

(3) The amount of coal and cost of same for each building for a period of two years follows: Steam-heated building—
1896-97, 372,710 pounds bituminous coal, at $2.30 per ton.$428 61
1897-98, 410,175 pounds bituminous coal, at $2.05 per ton. 451 18

Furnace-heated building—
1896-97, 393,435 pounds anthracite coal, at $5.60 per ton.$1,101 61
1897-98, 297,250 pounds anthracite coal, at $5.72 per ton. 850 14

(4) Repairs to apparatus from 1894 up to date: Steam-heated buildings, $84.62; furnace-heated building, $454.35. (5) A steam-heating apparatus, such as I now design, will certainly last twenty-five or thirty years. I know of a school building in Chicago which was equipped with a steam heating apparatus in 1856, and the wall coils, which extend around the class-rooms under the windows, are still in position and doing service. The boiler I removed about six or seven years ago, as it was inadequate to generate sufficient steam for additional heating surface which was placed in the building. Now, with regard to furnaces, I wish to state that the life of a fire pot is rarely over two years. Of course, when a defective fire pot is removed and a new one substituted, the furnace is practically as good as new. The large cast iron tubular furnaces give better results, but the large arch plates are liable to crack at any time, thus allowing smoke and gases to pass up into the rooms with the incoming air. During the past ten years furnaces were removed from thirty-six school buildings in the city of Chicago, with an average of about fifteen class-rooms each, and steam-heating and mechanical ventilating apparatus substituted. The Board of Education of the city of Chicago has not installed furnaces in any first-class school-building for the past sixteen years, except the one referred to in this communication, which is an addition to an existing building, the same being heated by furnaces, and the character of the old building was such that the introduction of modern steam-heating and ventilating plant to heat both buildings was not permissible.

THE MARINE ENGINEERS.

The first meeting of the Grand Council of the National Association of Marine Engineers of Canada, took place recently, at the Albion Hotel. The object of the association, which is intended to include all the marine engineers from the Atlantic to the Pacific, is to promote the interests of the engineers, to advance the standards, and see that none but those duly qualified according to law be employed in that capacity. Its intention is thus to protect passengers and the property of the steamship companies from all risks.

Several questions of interest to the calling were discussed, and the following officers were appointed: Grand president, D. L. Foley, Toronto; grand vice-president, Wm. I. Barton, St. John, N.B.; grand secretary-treasurer, S. A. Mills, chief engineer, Toronto Ferry Co., Toronto; grand conductor, Jas. A. McCarthy, Montreal; grand auditors, J. Fred. Williamson and G. T. G. Blewett, St. John, N.B. The constitution which will govern the society was adopted, and the meeting went on to discuss the bylaws. The next annual meeting will be held at St. John, N.B., in January, 1901.

LITERARY NOTES.

British Policy in South Africa. By Spenser Wilkinson. Publishers, Sampson Low, Marston & Co., London. One shilling.

Paul Kruger: His Life Story. By Fred. A. Mackenzie. Publisher, James Bowden, 10 Henrietta street, London. Illustrated. one shilling.

An illustrated catalogue describing the new McEwen gas engine will be issued in a day or two by the Waterous Engine Works Co., Brantford, Ont.

The Transvaal Trouble; How it Arose, being an abstract of the biography of the late Sir Bartle Frere. By John Martineau. Publisher, John Murray, Albemarle street, London. One shilling

The History of the Great Boer Trek and the Origin of the South African Republics. By the late Hon. Henry Cloete, Her Majesty's Commissioner for Natal, 1843-4; edited by his grandson, W. B. Cloete. Publisher, John Murray, Albemarle street, London. One shilling.

The Blacksmith and Wheelwright sends out a most attractive special number, which commemorates the twentieth anniversary of its establishment. An interesting feature of the issue is the announcement of the "20-year advertisers," as those are called who have occupied space in the Blacksmith and Wheelwright for that length of time.

The Mechanics' Supply Co., Quebec, has sent out this year the daintiest New Year souvenir that we have seen. It is a delft blue covered folder, tied with white ribbon, bearing on the front cover the words, "Greeting, 1899-1900." Inside, some apt quotations are followed by a couple of pages referring to the position and goods of this well-known company.

A great deal of attention is now directed to the Topeka Capital, a Kansas daily, which is to be placed absolutely at the disposal of C. M. Sheldon, author of "In His Steps," etc., that he may show what a Christian daily newspaper ought to be. If the experiment is continued long enough it is certain to succeed, because Canada has had for over sixty years a journal which has been consistently conducted upon this plan. It is The Daily Witness, Montreal.

"Machine Shop Companion," by Wallace Bentley, A.M.I. Mech.E., consulting mechanical engineer, Halifax, Eng., author

of "Sketches of Engine and Machine Details," etc. This book, which has thirty-six illustrations, is specially written for practical Engineers and Mechanics. It is bound in flexible cloth covers, suitable for the pocket, and is full of useful notes, rules, and tables for everyday workshop use, it shows in a simple way how to calculate speeds of pulleys, cones, wheels, etc., and includes an illustrated chapter on "Screw-Cutting," with list of Change Wheels, Notes on the Lathe, Drilling, Planing, Shaping, Slotting, Milling and Gear Cutting Machines; Notes on Materials, Forging and Welding, Hardening and Tempering, Case-Hardening, Templates, Gauges, Tables of Whitworth's Standard Screws, Taps, etc. The Bentley Publishing Co., Crossley street, Halifax, England.

"The First Night of a Play," "Through the Slums with Mrs. Ballington Booth," "What it Means to be a Librarian," by Herbert Putnam, Librarian of Congress, and "The Pew and the Man in it," by Ian Maclaren, are among the notable features of the February Ladies' Home Journal. An American Mother answers conclusively "Have Women Robbed Men of Their Religion?" and there is an interesting article on Mlle. Chaminade, the famous composer and pianist. Another article describes "Frank Stockton's New Home in West Virginia." The opening chapters of "The Parson's Butterfly," a new serial by Mrs. Charles Terry Collins, are also presented. Molly Donahue discusses woman's rights with Mr. Dooley, and "Edith and I in Paris," "Her Boston Experiences," and "The Autobiography of a Girl!" continue with increasing interest. The pictorial feature, "In Honor of St. Valentine," by Alice Barber Stephens, will recall some happy bygone days. By The Curtis Publishing Company, Philadelphia. One dollar a year; ten cents a copy.

No subject of interest to citizens of the British Empire in common has been so befogged with half-truths and with misrepresentations as the South African question. It is now generally known that besides the London edition of The Standard and Digger's News, controlled by the Transvaal Government, the Boers had—and in some cases still continue to have—subsidized newspapers on the continent and in the United States, which published and reiterated the most distorted and untruthful statements of affairs in the Transvaal. As many of these travesties of history originated as official statements from the Transvaal Government itself, and as British readers are apt to credit any other Government with the same respect for truth in official documents as would characterize their own Government, the Boer official falsehoods had been so widely and industriously circulated that when the war cloud burst a great proportion of people were in a mist as to the real facts of the case. The series of articles which have been appearing in this journal (now reprinted in pamphlet form under the title of the "Boer War") may have helped to dispel these mists from the minds of Canadian readers, but we are glad to call attention to the cheap and handy volumes above quoted, as further contributions to the literature of the subject, which will enlighten the Canadian reader still further on many points. The first named summary of the recently published biography of Sir Bartle Frere turns the search-light on the dealings of the Gladstone Government in South Africa at the time of the retrocession of the Transvaal to the tender mercies of the Boers. Leaving out of view Sir Alfred Milner, the present governor of the Cape and High Commissioner for South Africa, whose work is not yet accomplished, there have been in the history of colonial administration there three great governors, who understood and wisely estimated the problems of British relations with both the Dutch and the natives. These were first, Sir Benjamin Durban (whose mortal remains rest in the old Papineau Road military burying-ground in Montreal), Sir George Grey and Sir Bartle Frere. If the policy of the first two governors had not been thwarted by the Home Government, who sent them out, there would have been no Republic of the Orange Free State or the Transvaal to prove the thorns in the flesh of the rest of South Africa which they have; and if the policy of the last named had not been similarly thwarted even these separated communities would have been reconciled to the neighboring colonies, and we should have had a peacefully confederated South Africa to-day. One cannot rise from a perusal of "The Transvaal Trouble" without the feeling that Sir Bartle Frere was basely betrayed in his efforts to carry out his great aims, not only by the Gladstone Government, but by the Conservative opposition of that day, who selfishly sacrificed the higher interests of empire for party advantage in home politics. In the light of present events Sir Bartle Frere's estimate of the men with whom he was dealing from 1877 to 1880, and his judgment of the effects of the political movements then transpiring shows him to have been a man of extraordinary wisdom and foresight, and his predictions of what would happen if such and such a policy were carried out read now like pages of inspired prophecy. The statement in one of his letters that his administration would add another to the list of those whose teachings and work were not understood or appreciated till he was dead and gone, was itself a prophecy and has received its fulfilment in a way that must bring the blush of shame to some public men still sitting in the House of Commons, who deserted him in the hour of his trial. The memory of no governor in South Africa is to-day in higher regard, both among British and Boer, and if the British Government had only stood by him there would have been a confederation instead of a war there to-day. The "History of the Great Boer Trek" is a series of re-edited lectures on the motives of the great treks which led to the founding of the Free State and Transvaal, and in part to the colonization of Natal. The author, a loyal British subject of Dutch descent, treats the Boer's sentiments with natural sympathy, and shows us how they regarded the emancipation of the slaves in 1834-7, and how the blunders of governors combined with the vacillation of the British Government to produce that distrust and suspicion which are the regrettable national weakness of the South African Dutch, and which unfortunately have only been confirmed by the policy of the Gladstone and other recent British administrations. Mr. Wilkinson in his "British Policy in South Africa," takes up the question from the British and Imperial standpoint, but shows none the less clearly from this point, that party politics at home have been the curse of British rule in these colonies. Though this book was written before the war broke out Mr. Wilkinson saw that if Britain failed to maintain her position as paramount power or deserted the cause of the Uitlanders the Afrikander Bond would agitate for the independence of South Africa and British subjects, feeling deserted by their own Government, would make common cause with the members of the Bond. The loss of South Africa could then be only a question of a short time. Mr. Mackenzie's little book gives us a sort of crayon sketch of Paul Kruger, and avoiding politics as much as he can, desires to show us the man himself. He gives the old man credit for great virtues, but does not by any means hide his great faults. The result is a readable book, which has a number of half-tone illustrations. To those who wish more light on a subject of such vital interest to the future of the British Empire we can commend all of the above books.

AUTOMOBILE NOTES.

The whole of the Russian Imperial family, excepting the Czar, are enthusiastic chauffeurs.

The traction engines in use by the British army in South Africa do not seem to be very successful, according to some accounts.

In Algeria steam omnibuses are doing good work, and it is expected that they will be employed very largely in Madagascar.

There is scarcely anyone connected with the cycle and carriage building trades in France who is not interested more or less in the autocar industry.

A French count was sentenced to two months' imprisonment and fined $1,500 for breaking a lady's leg through his careless driving in the Bois de Boulogne.

The Stirling Motor Carriages, Ltd., of Hamilton, Scotland, has paid a five per cent dividend, and written $75,000 off goodwill account, as the result of last year's business.

The autocar as a delivery agency for newspapers in long, straggling country districts should prove invaluable. Two of the London Sunday journals have tried it with great success.

The Automobile Club of France has a membership of 2,000, a yearly income of $80,000, and the finest clubhouse in the world. Similar clubs have been formed in Berlin, Brussels, London, Turin, Geneva, London and New York.

A steam postal van has been sent to Ceylon from the Lancashire Steam Motor Co., of Leyland, England. It will carry a ton of mail matter in bags, and will make an average speed of ten miles an hour on ordinary country roads.

The Velo states that in France during December there were 708 accidents—52 deaths and 656 injuries—due to horses, and only 21 automobile accidents (causing one death) in the same period. There are about 4,000 automobiles running in France.

"Inshaw's Steam Wagon," or lorry, is running in Birmingham, made by the son of the worthy machinist of that name, whose early production of a steam carriage was illustrated in The Canadian Engineer last year from a photograph obtained from another member of the family.

The Municipal Council of Paris, France, has reduced autocar speed to 12 kiloms. in the Bois de Boulogne. The French correspondent of the Autocar suggests that the authorities should take in hand the task of regulating the horse traffic, and thus remove the chief source of danger to the automobilist.

The Motor Trades' Association has been organized in England "to afford mutual protection to its members, and to promote such measures as may be found useful in the interest of the motor industry in the United Kingdom, including the encouragement of invention, regulation of prices, and arrangement of shows."

The Autocar, of London, England, says everything points to a big motor year during the next twelve months, most of the manufacturing houses having experienced no "dead season" this year, as they have sufficient orders to keep them fairly busy all winter. One firm sold four motor cars in one week. The position of the autocar to-day is immensely superior to what it was twelve months ago.

Belgium, Germany and the United States will contest with the French champions for the Gordon-Bennett cup. It is reported that Mr. Riker and Mr. Winton have offered to represent the American Club, and that the former is having an electric car built specially for the race, which will be over a course of 125 kiloms. M. A. Lemaitre is having a 100 h.p. car with 8 cylinders built for this race.

The British Motor Car Club offer eight cash prizes, four of £100 each and four of £50 each, for the following inventions: An exhaust deodorizer, an automatic starter, the best ignition, and the simplest and cheapest design of motor and car complete. The winners of the prizes will retain to the full their interest in the inventions, which the club will assist them to get properly patented throughout the world.

A correspondent of the Autocar suggests "power-vehicle" as a comprehensive generic name for automobiles, while classes would be named "power-carriages," "power-carts," "power-wagons," and these again would divide up into sub-classes, as "power-landau," "power-victoria," etc. He objects to "motor," because of the many confusing senses in which it can be used. By the way, "Steamobile" appears in the Automotor journal.

The makers of steam carriages in the United States have struck a snag in a law which requires that anyone operating a steam road engine must be an expert engineer and be properly certificated. The Locomobile Co., who manufacture the Stanley steam carriage, are trying to get the regulations modified to allow the issue of "third or fourth class" certificates to owners of steam cars, who show themselves proficient in their use.

The Automobile Club of England is organizing a 1,000 miles efficiency trial, with the full approval of automobile manufacturers of Great Britain. The London Daily Mail has voluntarily offered prizes of $500 for the first, $250 for the second car coming through the trials best, and in addition, $50 to each car successfully accomplishing the journey. This club has been asked to officially take charge of the English automobile section of the Paris Exhibition.

The Autocar has made a careful calculation and reports that during 1899 very close on 2,000 automobiles of various kinds were made in or imported into Great Britain—this number being about equally divided between autocars and various descriptions of motor cycles. The trade in 1900 is likely to be increased at least 50 per cent. most probably doubled. The demand will be higher than this, but the ability to supply will affect the total at end of year.

The Autocar urges the British War authorities to investigate autocars as the German military man and the Emperor did, to their great satisfaction, the cars having carried weights up to 2¼ tons over bad roads, up hills, across stony and sandy track, and even on loose ploughed lands, and finally two baggage and two passenger wagons, heavily laden, satisfactorily competed with the Brocken railway in crossing the Brocken. The Emperor highly praised the performance.

The Chinese ambassador visited Coventry, Eng., in December, was met at the station by a fleet of motor cars, and after inspecting the factories made a speech in which he said: "The services rendered by the motor car to the field gun in time of war, as well as to the collection and distribution of mails in time of peace, are simply invaluable, and I have no doubt that when all our roads in China are restored these vehicles will be introduced into the far East, as well as they are now introduced into the West."

Here is an item from the Horseless Age of New York: "The Canadian Government has been experimenting for some time with various motive powers as a propelling force for mowers, reapers and other agricultural machinery. The tests have been made at Montreal, and one of the most recent was the driving of a gang plough by a gasolene motor, built by the Haynes-Apperson Co., Kokomo, Ind. It is said the motors will be attached to other farm machinery and produced in quantities."

H. Wilcke has written a pamphlet on "The Haulage of Goods on Common Roads," in which he shows that cheap production necessarily involves cheap transport; that British railways have made competition with other countries a difficult matter, instead of helping the producer; that within at least forty miles radius all transporting of goods can be done quicker and cheaper by self-propelled vehicles on common roads than by railways, and that all works on farms, no matter where, may thus have the equivalent of a railway siding.

New York has a new motor—not adaptable yet to carriages, but likely to develop on that line. It is called the "Secor," uses kerosene or heavy oil, feeding oil and air in chemically correct proportions straight into the cylinder, exploding by electric spark. It has neither oil pump nor vaporizer, exhaust invisible and almost odorless, while the motor runs 300 or 400 revolutions a minute, and governs so perfectly as to be able to drive a dynamo for variable electric lighting without going more than one volt out of the way—which is as good as steam engine performance.

The power required for motor vehicles may be gathered from the following figures showing tractive resistance, pounds per ton—ordinary metal tires and plain bearings being used: Railroads, 10; tramways, 30; good asphalt, 13, asphalt, 22; poor asphalt, 29; wood paving, 30; good setts, 35; best macadam, 42 to 46; good macadam, 50; ordinary macadam, 60 to 80; soft macadam, 97; best gravel, 57; cobbles, 60; ordinary cobbles, 130; very bad cobbles, 240; best clay, 110; hard dry clay, 100; sand road, 360; loose sand, 560. The authorities for above figures are Telford, Whyte-Smith, United States Agricultural Bureau, and Society of Arts.

A striking illustration of the unfairness of the British law limiting the speed of autocars to 12 miles per hour is shown by examining the time-table of the Tally-Ho Independent stage-coach, which ran between London and Birmingham in 1830. The distance, 100 miles, was covered in 7½ hours, the average speed, allowing for changes of horses, being over 13 miles per hour, and the actual speeds being as follows for the seven sections into which the trip was divided: 16.17, 18.75, 11.85, 14.64, 12.45, 16.50, 14.50. Only in one case is the speed below the autocar limit; yet this was in the days when the main highways were carrying their maximum of traffic, and were the only means of intercommunication, except canals.

Jenatzy, the famous French chauffeur, has driven his torpedo-shaped car, the "Jamais Contente" (never content), for one kilom. at the rate of 106 kiloms. an hour, and offers to bet $20,000 that he can drive it 100 kilom. in sixty minutes. The bet will likely be taken up by sporting men, and Jenatzy will risk this tremendous stake, as well as his life, on the result. The car would have to carry about two and a half tons of batteries, and this enormous weight added to the friction in flying over the

roads at such a rate, would, it is feared, very soon tear the tires to pieces. It would be interesting to calculate the force exerted by a four-ton vehicle at this speed in the event of meeting with an obstacle—a contingency not at all impossible.

Mr. Pennington, to whom The Canadian Engineer in its earlier days paid its compliments, is to the fore again in a characteristic exploitation. He seems to have joined forces with the equally well-known H. J. Lawson, of British Motor Co. fame. It appears that a company called the Anglo-American Rapid Vehicle Co., has been registered under the laws of the State of Delaware, the nominal capital being $75,000,000, and the working capital $10,000,000. It is understood that this company will take over the whole of the Pennington rights, both in Britain and abroad, as well as a considerable interest in the patents held by the British Motor Co., that it will also secure the Daimler patents for the United States, and organize for business throughout the world.

The weekly Horseless Age, of New York, devoted its issue of December 6th to steam, and that of January 17th to explosive motors. Some of the articles in the steam number were: Steam Boilers for Motor Vehicles, General Data on Steam and Fuel, Shell or Water Tube Boilers? Boiler Feeding Apparatus, A Practical Method of Utilizing Exhaust Steam, The Elihu Thomson Flash Boiler and Steam Vehicle System. Jas. A. Wright, of Montreal, wrote, strongly commending this issue, and giving his opinion that steam would find its most perfect expression through American work. The Explosive number contained articles on the Hydrocarbon Engine as a Source of Energy, Gasolene Engine Indicator Diagram, Ignition and Ignition Troubles, Vaporizers and Carburetters, Coils and Sparks, Vibration, Gasolene and Gasolene Mixtures, Multi-Cylinder Engines, Explosive Motor Data and Details. A correspondent of The Age objects to the term "Explosive Motor," saying, "An explosion does not occur in a gas engine; therefore it is wrong in principle to call it an explosive engine."

Hugh Dolnar, the able American correspondent of the Autocar, cleverly summarizes the situation in the United States thus: "Winton and Charron did not make a match, Davis and wife by dint of hard work and constant repairs of their 'National' wagon finally reached Chicago and stopped there instead of pushing on to San Francisco, the Walker $2,000 prize run was called off, and there has really been no clean cut and well defined item of autocar advancement in the United States the whole summer through. There have been charters granted, with vast nominal capitalizations, to many new companies, but when one goes out to look for the new and altogether satisfactory wagon he simply does not find it. It is pretty well understood that compressed air has something to talk about and nothing to show. The liquid air schemes, as all even tolerably well informed mechanics are aware, have not a ghost of a chance until somebody finds out something no one knows yet. The Stanley steam wagon has been delivered to many purchasers, and has given plenty of trouble to those who have tried to use it, in the way of scorched boilers and small water tank room. If a steam wagon is to be really popular it must condense its steam, and it must carry its water automatically: these two prime necessities are imperative demands, and cannot possibly be ignored. But underneath all of this seeming stagnation in automobile matters there is a fierce and stubborn contest going on between, perhaps, as many as 500 American inventors and the reluctant forces of nature. Everyone of these experimenters has set up a high standard of excellence, and is keeping well under cover, waiting the day of triumph before giving out anything to the public. We have come to pretty fully and clearly understand the severe exactions of the motor problem, and some of the Yankee mechanics will find good answer to the riddle, you may be sure of that."

—In the December issue of The Canadian Engineer an article on "Tall Buildings Under the Test of Fire," by H. De B. Parsons, was published. This article was written originally for The Engineering Magazine, but was republished in the reports of the British Fire Prevention Committee.

—Canadian trade in Australia increased between 1896 and 1898 at the rate of more than three hundred per cent.

Industrial Notes.

Tadoussac, Que., is to have a system of waterworks next year.

The Berlin, Ont., waterworks earned $5,000 for the town last year.

The Abbott-Mitchell rolling mills at Belleville, Ont., are now in operation.

The O. W. Thums Co. is starting a factory at Walkerville, Ont., for the manufacture of fly paper.

A new bridge is proposed over the Castor River between Carleton county and Prescott and Russell.

The new glass factory at Kingsville, Ont., started up the first week in January, using natural gas as fuel.

Five new buildings are being erected at Granby, Que., in connection with the Granby enamelware works.

Moose Jaw, Assa., is discussing the raising of $75,000 to be spent in local improvements of a permanent sort.

The W. W. Ogilvie Co. is applying for incorporation to carry on the flour milling business of the late W. W. Ogilvie.

The Shawenegan Falls Hotel Co. is being incorporated to build a $25,000 hotel at Shawenegan Falls, Que. B. Shepherd, manager.

The Hamilton Iron and Steel Company, Hamilton, has just put in a new boiler which was supplied by the Goldie & McCulloch Co., Ltd., Galt, Ont.

J. McCrois' new foundry at Lindsay is nearly completed It is 35 x 68 feet, and two stories high. A second building, 45 x 45 feet will be put up in the spring.

The Bain Wagon Co., Woodstock, Ont., has built for the Department of Militia sixteen special wagons, which are being sent out with the Second Contingent.

The ratepayers of Cookshire, Que., have voted a $15,000 bonus to the Canada Food Supply Co., and it is expected that the company will start its cannery building at once.

The Goldie Milling Co., Highgate, Ont., has put in a Moffatt Feed Water heater. The Goldie & McCulloch Co., Ltd., Galt, Ont., is sole Canadian maker of this heater.

Mrs. Doran, of North Bay, widow of Judge Doran, formerly of Perth, Ont., has sold a water power on the Spanish River, near Webbwood, Ont., for $12,000, to a pulp syndicate.

The St. Charles Condensing Co., Ingersoll, Ont., has received some heavy special machinery from the Goldie & McCulloch Co., Ltd., Galt, Ont., for the new condensing works.

The Smart-Eby Machine Co., Ltd., Hamilton, Ont., is turning out a 75-ton refrigerating plant for a large brewery. The plant is modeled on the Buffalo Refrigerating Co.'s plans.

An elevator and flour mill company has been formed at Morinville, Alberta, under the title La Compagnie d'Elevateur et de Moulin a Farine de Morinville. The capital is $15,000.

The Walkerville, Ont., Match Co., promoted by Peter Stenius will have their new match factory running some time in March. A large part of the machinery comes from Sweden.

The present output of the Nova Scotia Steel Company is about 100 tons of steel per day. Seven hundred men are employed at the company's works at Trenton and Ferrona, N.S.

Work at the Maritime Clay Works, Pugwash, N.B., will be resumed shortly, it is said. A continuous kiln for burning brick is to be built, and it is said will take 450,000 bricks to build it.

A great deal of activity is evident at the charcoal iron plants at Radnor, Que., operated by the Canada Iron Furnace Co., and also at the Drummondville furnaces worked by the McDougall estate.

The Paisley, Ont., Pork Packing Company, Ltd., recently organized there, with a subscribed capital of $10,000, has bought the old Northern Hotel property, and intends fitting it up immediately.

J. Oliver & Sons, Ltd. has been incorporated to manufacture and deal in furniture in Ottawa, Ont., and carry on the business now being done by Jos. Oliver & Sons; the capital of the company is $90,000.

The Canadian Food Supply Co., Montreal, is being incorporated with $50,000 capital, to can meat, vegetables, etc. W. Pendy, J. Lawson, A. Dunlop, E. Bailey and S. Jamieson are the provisional directors.

The Keewatin Lumber and Manufacturing Company, Keewatin, Ont., is building a mill dam and putting in a new and larger water wheel. Before spring one of the circular saws will be replaced with a band saw.

The very large quarries at Marble Mountain, N.S., have been bought by the Dominion Iron and Steel Company. Quarrying operations will begin at once and shipments will be made over the I.C.R. to Sydney, C.B.

Tenders for the steel or wooden bridge across the Thompson River at Kamloops, B.C., will be received up to February 28th. Plans are at the Lands and Works office, Victoria, B.C. W. S. Gore is deputy commissioner.

A. Roy is to establish a foundry at Toronto Junction. The town grants a site at a nominal price and Mr. Roy undertakes to put up a brick building, 100 x 50 feet, to be completed by June 1st, and to employ at least five men.

Application for incorporation is being made by the Stuart-Arbuthnot Machinery Company, Ltd., to take over the business of Stuart & Harper, machinery, Winnipeg. John Arbuthnot, lumber dealer, is a new member of the firm.

A company has asked for incorporation to own and operate a threshing and flour mill and a lumber mill at Beaumont, Alberta. The name of the company is Le Compagnie des Moulins de Beaumont, and the capital is $4,000.

It has been announced in Toronto that the Heinz Pickle Mnfg. Co. would at once establish its proposed Canadian factories in Toronto. The company has started a European trade, and the English market will be supplied from Canada.

The new Maria street bridge, Ottawa, will have two stone piers and two stone abutments. There will also be about twenty little foundation piers, on which will rest the end of the iron pillars that will support the structure over the railroad tracks.

The Goldie & McCulloch Co., Ltd., Galt, Ont., has shipped a high-speed Ideal engine to Sarnia, Ont., for the Canadian General Electric Co., of Toronto. The Montreal Rolling Mills Co. recently purchased one of these engines from the same company.

J. E. Murphy, Amabel; R. P. Butchart, Keppel; G. S. Kilbourne, J. Lucas, J. M. Kilbourne and D. M. Butchart, Owen Sound, Ont., have been incorporated as the Shallow Lake Portland Cement Co., Ltd.; capital, $199,000; chief place of business, Owen Sound.

Redpath-Reid automatic smoke consumers have recently been supplied by the Jubilee Grate Bar Co., Ltd., to McClary Mnfg. Co., London, Ont.; Canada Screw Co., Hamilton; Beaver Mnfg. Co., Hamilton; Lyman Bros. Co., Toronto; Sanford Mnfg. Co., Hamilton.

The Gyrator System of Flour Milling, of which the Goldie & McCulloch Co. is sole Canadian maker, is meeting with great success in the milling world. The company has recently shipped a car-load of this kind of machinery to the Farmers' Milling Co., Fort Saskatchewan, N.W.T.

La Compagnie de Pulpe de Jonquiere is applying for legislation to enable it to expropriate lands on Riviere aux Sables and on Lake Kinogami in the county of Chicoutimi, Que., and develop the water power of the Riviere aux Sables, throughout its entire length, and to build pulp mills.

The Halifax Herald stated recently that a new wing and pattern shop have been added to the Cape Breton Foundry and Machine Co., Sydney, C.B. The St. John brass founders, T. McAvity & Sons, who have large contracts with the Dominion Iron and Steel Co., are preparing to erect a branch foundry at Sydney.

The following application to the Ontario Government for power to issue bonds are made: Meaford, $56,000, to bonus the Botsford Jenks Co., of Port Huron, Mich., and the G. T. R. elevator; Dunnville, $10,000, to bonus F. R. Lalor in establishing a tanning factory; Port Perry, $5,000, to aid a House of Refuge and Industrial farm for the county of Ontario; Port Hope, $20,000, to enlarge the waterworks.

The Ironsides Mining Company, Ltd.; capital, $100,000; headquarters, Ottawa, is being incorporated to develop iron mines near Ottawa city. The provisional directors are: W. L. Holmes, Detroit; J. L. Robertson, W. R. Hinsdale, New York; J. O. Hibbard, C. B. Hibbard, D'Arcy Scott and W. H. Curle, Ottawa.

R. F. Prefontaine, Q.C., Montreal; J. A. C. Madore, Q.C., A. R. Angers, O. Rolland, J. L. Decarie, A. Beauvais, J. L. Warren, M.D., J. A. Drouin, Montreal; P. V. Savard, Chicoutimi, and J. Warren, Pointe a Pic, are being incorporated as the Great Northern Elevator Co., to build elevators in Quebec city and elsewhere.

The Weymouth, N.S., mill of the Sissiboo Pulp and Paper Co. is now turning out 300 tons of dry pulp per month. New machinery is being added and preparations are under way for building a new dam and a large mill in the spring, for which machinery is now being contracted for. The new plant will be in operation by November 1st next.

The North River Lumber and Pulp Company, Ltd., is being incorporated, with a total capital stock of $50,000; headquarters at Valmorin, Que.; to carry on the manufacture of pulp, paper, etc. The following are the names of the petitioners: C. R. Burleigh, Whitehall, N.Y.; G. W. Macdougall, Wm. J. Henderson, A. R. Macmaster and H. McKay, Montreal.

A circular issued by the G.T.R. announces that the special rates on pulp wood out of Canada to points in the United States have been withdrawn, and the regular tariff at a much higher rate has gone into effect. This has been done, it is said, to help encourage the manufacturers of pulp and paper in Canada. The low rates on pulp wood to and from local points will continue the same as before.

Canada is gradually taking her place among countries who can manufacture for the world. Last autumn the Goldie & McCulloch Co., of Galt, shipped to Mexico two car-loads of bagasse filters to be erected on Mexican sugar plantations, and each season the same company exports to Cuba several thousand dollars worth of sugar machinery. Before the Boer war they also shipped mill machinery to Lorenzo Marques, in Portuguese South Africa.

J. L. Jennison, one of the directors of the New Glasgow Milling Company, recently stated that the company proposes to build mills at St. John, N.B., and Halifax, N.S., in addition to that at New Glasgow. They have obtained a new charter from the Dominion Government granting them more extensive rights than the local charter under which they have been working. The name of the company has been changed to the Maritime Milling Company.

The B. Greening Wire Co., Hamilton, Ont., has now completed the issue of all the catalogues of perforated metals, wire cloth and screens of all widths, sizes and grades, wire rope, steel or iron wire, window guards, flower stands, counter railings, foundry supplies, etc., handled by the company. To mail any of these catalogues to interested parties will be a pleasure to the company, if they will state which department they are interested in.

The American School of Correspondence, Boston, Mass., is now exceeding its operations in Canada. A folder recently issued repeats what a number of Canadians write about this school. Among those who have examined the literature and examination papers of the school, and certified to their value, are H. T. Bovey, LL.D., M.I.C.E., F.R.Sc., McGill University; J. Galbraith, principal of School of Practical Science, Toronto, and a large number of others.

About 150 couples, among whom were many prominent labor advocates, attended the annual concert and "At Home" of Toronto Branch No. 46 of the Plumbers', Steam and Gasfitters' Association, held January 26th, in the Confederation Life Building, Toronto. Mr. Robert Harrison presided at the concert. The program was contributed to by Messrs. W. Street, A. Parker, H. Bates, W. White, F. Hancock Matthews, J. Dempster, F. Wray and Master Owens. During the concert the handsome silver cup donated by the Toronto Letter-Carriers for the best appearance of any one union organization in the Labor Day parade, and which was awarded to this union, was handed over to the victors.

A deputation, of which E. F. B. Johnston, Q.C., was spokesman, waited on Hon. E. J. Davis last month, and asked a concession from the Ontario Government of certain lands on the Montreal river, which flows into Lake Temiscamingue. The syndicate proposes to expend $100,000 on a plant, and agrees to employ 25 men during the first year. Those interested are: W. C. Phillips, Dr. Lynd, P. McArthur, R. Davies, W. R. White, W. Kerr, John Gray, A. Niven, John Ferguson and E. F. B. Johnstone.

The Dowd Milling Co., Ltd., is applying for incorporation; capital, $100,000; headquarters, Quyon, Que., to mill oatmeal, flour, etc. The following are the applicants: H. S. Dowd, Quyon; B. W. Dunnett, Pakenham, Ont.; J. A. Cameron, Dominionville, Ont.; G. T. Mohr, J. Amm, Quyon; J. Pritchard, North Wakefield, Que.; D. B. Maclaren, Fitzroy, Ont.; R. H. Sayer, Aylmer, Que.; E. Graham, Bristol, Que.; W. H. Meredith, Quyon; G. Walsh, Onslow, Que.; C. Brooks, Quyon, and W. Harrison, Quyon.

Some time ago the boiler in the Crescent Milling Company's factory, London, Ont., exploded, wrecking the brick engine-house, but not damaging the factory close by. The force of the explosion moved the boiler about fifty feet. Fragments of the engine-house were afterwards found two hundred feet away. J. Hetherington was the only man in the engine-house at the time. He was seriously scalded about the head and shoulders, but was not fatally hurt. The cause of the explosion is said to have been the giving way of a patch in the end of the boiler.

It is stated from Quebec that a new proposition for the establishment of refrigerators and abattoirs in the district of Quebec is to be made shortly to the Provincial Government by various tenderers for its consideration before the coming session. The proposal contemplates a fixed subsidy not exceeding $30,000 a year for a certain period, instead of the previously proposed guarantee of 3 per cent. on $1,000,000, not to be paid till the business has been established, and some $500,000 spent on buildings and plant.

A special train took 500 laborers from Boston, U.S., for Sydney, C.B., recently. They will be employed on the construction of the large plant of the Dominion Iron and Steel Company, Ltd. Workmen of all kinds, from all parts of the country, are going to Sydney, where an opportunity for employment awaits most who apply. It is expected that within six months from two to three thousand workmen will be employed upon the plant in the capacity of carpenters, blacksmiths, steamfitters, plumbers and ordinary laborers. In all cases those who have gone have paid their own railway fares.

Justice Rose, Toronto, has granted an order to wind up the business of the Canadian Locomotive and Engine Company of Kingston, and appointed A. F. Riddell, of Montreal, accountant, as provisional liquidator. The application was made on behalf of James W. Pyke, of Montreal, a creditor, and the order was consented to by the Bank of Montreal, who are the heaviest creditors of the company, which admitted its insolvency. A meeting of creditors, shareholders and contributories will be held at Kingston on Feb. 10, when the question of the appointment of a permanent liquidator and other matters will be decided upon.

The Canada Paint Co., Ltd., Montreal, Toronto and Victoria sent out a circular at the end of last month stating that the price of the best paints, such as the "Elephant," "Prism" and "Stag" brands had been advanced to $1.20; their extra grade floor paints to $1.10, and their standard grades to $1 per gal. The reason given for these advances is the rise in the price of turpentine, oil, lead, zinc and tin cans. Since "Elephant" paints were $1 lead has advanced 2c. per lb., zinc 1½c. per lb., linseed oil 18c. per gal., turpentine 20c. per gal., and tin cans average an advance of 4c. per gal. This advance is said to be equivalent to 28c. per gal.

The Ontario Association of Architects held its annual meeting, January 16—19th in Toronto. The business proceedings have to a great extent centered on the resolution to establish themselves in a headquarters on King street, with a suite of rooms suitable for the usual meeting of the society, and for classes, sketch clubs and other assistance to the education of students, which it is desirable to establish. The new council of the association are: President, A. Frank Wickson; first vice-president, Fred Henry, London; second vice-president, Grant Helliwell; treasurer, F. S. Baker; council, G. E. Belcher (Peterborough), S. H. Townsend, W. A. Langton, G. A. Pearson, A. H. Gregg; honorary registrar, W. R. Gregg.

The proposed system of waterworks and sewage for the town of Gananoque, Ont., as designed by Willis Chipman, C.E., is estimated to cost $120,000, as follows: Intake pipe laid, $5,000; pump house, $4,000; machinery, $5,000; water tower, $7,000; 300 tons of cast-iron pipes and specials with 41 fire hydrants, valves, etc., $13,000; trenching, cartage, pipelaying, lead backfilling, and all other labor exclusive of rock work, $6,000; one third cost of rock in 18,000 feet of trenching, and all the cost in 2,500 feet, $16,000; two sewer outlets, each 400 feet long, $3,000; 24,000 feet of sewer pipes and all other materials, $11,000; 25,000 feet of excavating, pipe laying, jointing, backfilling, and all labor exclusive of rock work, $14,000; two-thirds the cost of rock in 16,500 feet of trenching, and all on 8,500 feet, $36,000.

The following company announcement is among the most important that has been published for some time in the Ontario Gazette: Francis H. Clergue, Bertrand Clergue, Ernest V. Clergue and H. C. Hamilton, of Sault Ste. Marie, and E. S. Douglas, W. P. Douglas and F. S. Lewis, of Philadelphia, U.S., have been incorporated for the following purposes: (a) As a contractor, to construct railway and public and private works of all kinds and to equip the same and operate any of the works constructed by the company except railways; (b) To acquire by legal title mines and mining lands, timber and timber lands, and other lands, and to lease, sell, or otherwise dispose of the same; and (c) To manufacture and sell the products of raw material; the corporate name of the company to be the Algoma Commercial Company, Ltd.; and its share capital to be ten million dollars, divided into 200,000 shares of $50 each; the head office of the company to be at the town of Sault Ste. Marie.

The Elastic Carbon paint which is being put on the market by the Atlantic Refining Co., Toronto, is being warmly recommended for roofing purposes. The company states it to be unexcelled for roofing purposes of every description. It will make a worthless roof practically as good as new and make it serviceable for years at a comparatively small expense when otherwise an entirely new roof would be necessary. It is said to make a roof, be it metal, canvas, wood, felt or shingle, impervious to water; also makes a splendid appearance on metal roofs, it filling the seams and small holes, making them perfectly waterproof, preventing formation of rust. In covering capacity it far exceeds ordinary paint it is said. On felt, paper, canvas and shingle roofs, one gallon covers 100 square feet, while on metal and other smooth surfaces one gallon covers 250 to 300 square feet. It is used for painting bridges, steel plates, vessel bottoms, piers, etc. Gives a lustre similar to enamels and possesses all desirable features of a metal paint. It can be used for agricultural implements, painting fences, pumps, and iron work of any description.

As a result of a meeting of the Canadian Furniture Manufacturers' Association held in Stratford, Ont., on December 27th, 28th and 29th, the British American Furniture Co., Ltd., has been incorporated with a capital stock of $3,000,000 divided into 30,000 shares, of which 20,000 shall be preferred. J. R. Shaw, J. L. Tangher, Toronto; W. H. Hobbs, T. S. Hobbs, London, and Wm. McN. Shaw, Walkerton, Ont., are the provisional directors of the company, which will have its head office in Toronto. So far as at present known twenty-four firms will come under the syndicate. They are: W. R. Hobbs, London; Snyder, Roos & Co., and Schaefer, Keeler & Co., Waterloo; J. S. Anthes Manufactory Co., The Simpson Co., and H. Krug, Berlin; Burr Bros., Guelph; Knechtel Furniture Co., Hanover; Krug Bros. & Co., Chesley; Siemon Bros. Manufacturing Co., Hill Chair Co., and Jas. Young, Wiarton; Watson Malcolm, Kincardine; Broadfoot & Box, Furniture Co., Seaforth; Thos. Bell & Son Manufacturing Co., and Button & Fessant, Wingham; E. F. R. Zoellner, Mount Forest; The Furniture Manufacturing Export Co., Berlin; L. Hahn, New Hamburg; American Rattan Co., Walkerton; Jos. Orr & Sons and George McLagan, Stratford; Union Furniture Co., Wingham.

—The fifteenth annual meeting of the Illinois Society of Engineers and Surveyors was held in Moline, Ill., 24th, 25th and 26th ult. A number of valuable papers were read. Almon D Thompson, president, presided.

Personal.

The employees of the L.E. & D.R.R. presented mechanical superintendent Austin with a Morris chair and an address a short time ago.

Jas. McGregor, British Columbia inspector of metalliferous mines, was reported to be in the Greenwood, B.C., hospital seriously ill with pneumonia recently.

Robert Surtees, C.E., late city engineer, Ottawa, Ont., has been appointed consulting engineer of the Government Commission appointed to expend $60,000 annually in beautifying the city.

T. B. Hart, one of the best known contractors in Ontario, died at his home in Toronto recently, aged 71 years. Mr. Hart was the contractor for the crib-work at the Eastern Gap, Toronto harbour.

J. R. Adamson, manager of a department in the Vancouver, B.C., Hardware Co.'s store, who was formerly in the employ of the Rice Lewis & Son, Ltd., Toronto, was fatally shot while out hunting, January 13th.

The Grand Trunk Literary and Scientific Institute has been made the recipient of a handsome large portrait of Frank W. Morse, the superintendent of motive power, which will adorn the walls of the institute alongside those of other officials of the company.

H. J. Somerset, operating manager of the Winnipeg Electric Street Railway, has received and accepted a position as general manager of the tramways, Perth, West Australia. He is a son of W. B. Somerset, business manager of the Winnipeg Free Press.

Alfred Rubbra, who has been for many years manager for H. W. Petrie, Toronto, has removed to Montreal to take charge of the sales department of the Laurie Engine Co., succeeding Charles Bethell, who has been appointed manager of the Northrop Loom Company's works at Valleyfield, Que.

Samuel Walker, who for seventeen years has been foreman and general foreman at the shops of the Grand Trunk system, at Point St. Charles, having been selected general foreman of the Dominion Bridge Company's works at Lachine, has received a handsome parting presentation from his late fellow employees.

The Cataract Power Company has appointed H. R. Leyden, manager of the Hamilton Electric Light Company, in place of Gordon Henderson. Mr. Henderson and Mark Thomas, late manager of the Hamilton and Dundas railway, have been offered other positions by the company. C. K. Green is manager of the consolidated lines.

The following changes in the staff of the Grand Trunk Railway shops consequent upon the resignation of Samuel Walker are announced: Foreman of erecting shop, J. Farrar; assistant pro tem. to Mr. Farrar, R. Cowan; foreman of machine shop, J. Millington; assistant to Mr. Millington, F. Dalrymple; foreman of wheel shop, A. W. Dutton.

Napoleon Savard, 23 years of age, a telegraph lineman, died from an electric shock which he received while at work in Montreal, January 2nd. He and his brother were replacing and coupling wires at the top of a pole. Napoleon Savard was in the act of splicing two ends of wires. He had no rubber gloves on, and received a strong shock. He grasped the wires convulsively with both hands, and was badly burned, the shock proving fatal.

A. D Benjamin died in Toronto of heart failure last month. Until about a year ago he was senior partner in the well known firm of M. & L. Samuel, Benjamin & Co. Mr Benjamin was born in Melbourne, Australia, 1848, and in 1854 removed to England with his father. He graduated from the University of London in 1865, receiving the degree of B. A. with honors. He first located in Montreal, then returned to England, but finally settled in Toronto about the year 1878, and became a partner in the business already mentioned.

W. A. Carlyle late Government mineralogist of British Columbia, and a most distinguished graduate of McGill University, Montreal, left London, Eng., for Spain about the 1st of Jan., to assume a position which is the best obtainable in the mining profession, namely, the managership of the Rio Tinto mines, Spain, where his salary will be $25,000 a year. In an interview before leaving London he denied the report that his resignation of the managership of Le Roi mine in British Columbia was due in any way to a disbelief in its future. It was simply a question of accepting an infinitely better position. The mining future of British Columbia, he said, was very bright. He spoke of the incalculable harm which he said had been done by the eight-hour law, which checked mining work at a very important time in its history.

J. R. Roy, son of Rouer Roy, Q.C., Montreal, whose appointment as secretary to the Public Works Department was announced a short time ago from Ottawa, received very pleasing testimony to the esteem in which he is held in British Columbia before he gave up his position as Dominion resident engineer there. The New Westminster city council unanimously passed the following resolution: "That this council desires to place on record its appreciation of the services rendered this corporation, from time to time, by J. R. Roy, Esq., C.E., during the four years he has been at the head of the Public Works Department in British Columbia, and, while gratified to learn that his removal to headquarters at Ottawa is in the line of promotion, it cannot but express regret at the departure of an official so painstaking and courteous, and with whom the council's relations have been invariably pleasant and satisfactory." Mr. Roy was also tendered a dinner, which was attended by a large number of well known people.

Electric Flashes.

The Niagara, St. Catharines & Toronto Railway Company will build an electric railway to Hamilton.

The Belleville, Ont., city council has refused an unlimited franchise to the Trenton Electric and Water Company.

The Woodstock, Ont., council, has refused a 50-year franchise to an electric railway between that town and Ingersoll.

An electric line is spoken of to connect the graphite mines near Calabogie, Ont., with the Kingston and Pembroke Railway.

We have received a handsome steel letter opener with bone handle from the well-known electrical firm of Ahearn & Soper, Ottawa.

The right of way granted the Preston and Berlin Railway expired on 15th ult., but it was extended for six months by the Berlin, Ont., council.

Jos. Hughes, formerly employed by the Montreal Street Railway Co., is now superintending the construction of San Paulo Railway, Brazil.

The Electrical Construction Co., of London, Ltd., has recently installed a 500-light dynamo for the North America Bent Chair Co., of Owen Sound.

The London Printing and Lithographing Co., has recently installed a 150-light dynamo, the Electrical Construction Co., of London, Ltd., having the contract.

Alfred Fairbairn, who for a number of years has been paymaster of the Montreal Street Railway, is now comptroller of the West India tramway, Kingston, Jamaica.

Young Bros., iron founders and machine builders, Almonte, Ont., have installed a plant to light their works. They built most of it themselves, and it is most successful.

The Ottawa and Dundas Electric Railway is applying for a charter to build a line from Ottawa, Ont., to the St. Lawrence River in Dundas county, and to build branches.

The Renfrew Electric Light Company has been incorporated and is getting their plant ready. The authorized capital is $75,000. A. A. Wright is president and manager.

The returns at the Interior Department at Ottawa show that the receipts for the first two months that the Yukon telegraph line was in operation amounted to over $13,000.

The Fire and Light Committee of Woodstock, Ont., has been authorized to obtain figures for the purchase of the electric lighting plant and the introduction of an all night lighting service.

The Electrical Construction Co., of London, Ltd., has received an order from John Starr, Son & Co., of Halifax, for an 8-h.p. motor.

The Fraser Cap and Fur Co., of London, has recently placed an order with the Electrical Construction Co., of London, Ltd., for a new increased size of motor for its factory.

The villages surrounding Lake St. John are being gradually lighted by electricity. Roberval has been so lighted for some time, and now Jonquieres is to be similarly illuminated.

The Beattie Mnfg. Co., Toronto, has placed an order for a larger motor with the Electrical Construction Co., of London, Limited.

The dates decided upon for the twenty-third convention of the National Electric Light Association are the 22nd, 23rd and 24th of May, 1900. The meeting will be held in Chicago, Ill.

Achille Gagnon proposes to connect Victoriaville and Arthabaskaville, Que., with an electric railway, providing the ratepayers of Arthabaskaville vote the bonus offered by the council.

The Hamilton-Galt-Berlin Electric Railway Company will apply to the Legislature at its next sitting for an Act extending the time for the building and completion of the company's lines of railway.

The Stratford Clothing Co. has recently placed an order with the Electrical Construction Co., of London, Ltd., for an 8 h.p. motor.

Three motors for operating from 110 volt private isolated plants have been shipped to Winnipeg by the Electrical Construction Co., of London, Ltd., of 12, 4 and 3 h.p. capacity respectively.

The Sydenham Glass Co., of Wallaceburg, Ont., is still adding to its fine equipment of machinery, having recently placed an order with the Electrical Construction Co., of London, Ltd., for a 60-light dynamo.

The Toronto and Hamilton Electric Co., manufacturer of dynamos, motors and all electrical apparatus, has moved into the new premises, which is a ten-story building, 60 x 100 feet, Nos. 99, 101 and 103 McNab street, Hamilton, Ont.

A number of Ingersoll, Ont., business men are taking steps to secure a charter for an electric railway. The charter aims at the same running powers between the towns as the Woodstock, Ingersoll and Thames Valley Railroad Company are seeking.

The Electrical Construction Co., of London, Ltd., has already placed several of the eighty second-hand machines recently returned from Winnipeg. Those who have inspected these machines say there are many good bargains among them.

The city engineer of Hull, Que., is at present engaged in preparing plans for the new dynamo house to be erected, to be in operation by August next. The plans call for 75 arc lights. About six miles of streets will be lighted. Power will be secured from two 50-light dynamos.

The Woodstock Sentinel Review has been considered lately as a model printing house. It has recently added to its already extensive plant an 80-light dynamo and wiring; the contract for which was given and has been completed by the Electrical Construction Co., of London, Ltd., for the multipolar type apparatus

Hon. P. Garneau, V. Chateauvert, J. T. Ross,, Hon. J. Tessier and the Hon. J. Sharples, Quebec; J. McNaught, New York and H. H. Melville, Boston, are being incorporated as the Labrador Electric Light and Power Company, to develop water powers on the Murray Bay River, Quebec, and to build electric lines and paper mills.

The James Cooper Co., Montreal, are suing the War Eagle Gold Mining and Development Co., Ltd., for $150,000, for alleged libel and slander, in connection with the installation of the electric hoist and compressor plant in the War Eagle mine. It is claimed an untrue statement was made, damaging to the Cooper Co., as a business concern.

The inventive talent of the best engineers has been taxed ever since alternating current became popular, to devise a voltage regulator which would be simple in construction and yet be satisfactory in operation; few are said to have attained this. The Chapman Voltage Regulator seems to be meeting with unqualified success. The regulators are manufactured by the Belknap Motor Co., of Portland, Maine, whose Canadian business has been placed in the hands of Munderloh & Co., the well-known electrical firm of Montreal.

Jack & Robertson, Canadian sales agents for Sprague Electric Co., New York, specially call attention to the Flexible Metallic Conduit (pages 103-112, of their new catalogue No. 75), which, owing to its low price, and saving of labor in installing, is said to have considerably reduced the cost of modern conduit work; even more so than did the introduction of uninsulated plain iron pipe.

The Divisional Court at Toronto held recently that the Lord's Day Act does not restrict electricians from working on the Sabbath, as they are not expressly mentioned. Electrician Mashinter, of Huntsville, Ont., was convicted lately for violating the provisions of the Act while at work in Shaw, Cassels & Co.'s tannery, but on the application of solicitors the court quashed the conviction.

The Bell Telephone Company has just completed and opened a heavy long distance copper metallic circuit line between Ottawa, Carleton Place, Smith's Falls and Brockville, Ont. It required upward of 3,500 poles, 4,000 cross-arms and 75,000 lbs. of copper wire. This line gives Ottawa a direct long distance service with Buffalo, N.Y., and other western points, and a material reduction has been made in the rates.

The Niagara and Southwestern Electric Railway Company, Ltd., is applying for incorporation to build an electric railway from Niagara-on-the-Lake through St. Catharines and Smithville to Hagersville, Ont., with branches from Decew Falls to Hagersville via Dunnville and Cayuga, and from Niagara-on-the-Lake to Queenston, passing where necessary through the counties of Lincoln, Welland, Haldimand and Wentworth.

The Electrical Review, New York city, begins the new year with a special double number which is remarkable for its valuable contributions, handsome illustrations and typography. A new dress of type, a change in the color of the cover and a more up-to-date arrangement of reading pages are some of the improvements made. The contents include a review of electrical progress during 1899 in the United States, Great Britain and the continental countries of Europe.

A plan is proposed by Messrs. Denniston and Payne for the development of power at two points at Niagara Falls. The first would be where the Chippewa flows over the bluff in the park. Here it is thought 30,000 h.p. could be developed. Then by conducting the water in a canal through the park to a point below the Falls, and utilizing the fall into the River Niagara, the power could be increased to 100,000 h.p. For this scheme, it is stated that English capital is forthcoming.

That the Canadian Niagara Power Co. will develop power in the Victoria Park is now stated on the authority of W. B. Rankine, vice-president of the company. The actual work will commence next fall, although some preliminary steps will be taken before then. The Canadian plant will be completed within two years, as this was the period required to sink the wheel-pits and construct the tail race on the American side. The first development will consist of from 15,000 to 25,000 h.p.

The Shawenegan Water and Power Co., at the falls of that name, is spending $300,000 this winter, over 1,000 men being engaged. The Shawenegan Carbide Co., of which William Mackenzie, Toronto, is said to be a leading shareholder, has agreed to take 10,000 h.p., while the Pittsburg Reduction Co., whose works are also to be established on the St. Maurice, will also take a great deal of power. Thirty houses a month are being built, and it is expected that the St. Maurice will be dotted all the way from Three Rivers up to the Great Northern Railway by a flourishing manufacturing community.

W. H. Browne, general manager of the Royal Electric Company, Montreal, stated a short time ago that the company had despatched to the Nova Scotia Steel & Iron Company a complete electric lighting plant, consisting of a two phase generator and complete equipment of sixty alternating current enclosed arc lamps. This is said to be the first installation in Canada where an alternating current generator has had its entire capacity taken up with arc lamps alone. He stated further that the company, in conjunction with the Waterous Engine Works, had secured the contracts for the new electric light service to be installed at Greenwood, B.C.

The Court of Appeal has reversed the judgment of the Court of Review and confirmed the judgment of the Superior Court in the case of the Ottawa Electric Company and the Hull Electric Company. By the present judgment the Ottawa Electric Company is declared to have the right to compete with the Hull Electric Company; the bylaw of the city of Hull, Que., giving exclusive rights to the Hull Electric Company, is declared to create a monopoly, and the act of the legislature confirming said bylaw is declared to be unconstitutional.

The establishment of the Marconi system of wireless telegraphy in the northern part of Newfoundland, and along the Labrador coast, seems to be contemplated by the Newfoundland Government, whose Minister of Marine and Fisheries, in a recent interview, stated that the plan at present thought of, if arrangements can be made with Marconi for instruments, fitting up, etc., is to connect the Labrador coast with the nearest telegraph station on the island, probably Tilt Cove. The distance between Tilt Cove and Rameo, Northern Labrador, in a line along the coast, is something over 850 miles. This means that 18 stations at a distance of about 50 miles apart would be placed.

The Metropolitan Electrical Co., Ottawa, is employing 300 men and 50 teams of horses on its power works at Britannia, Ont. There are in operation five steam drills, three steam derricks, a steam dredge, two locomotives and fifty flat cars, comprising part of the plant. The total length of the canal is about 3,000 feet, about 1,200 feet of this is solid rock, through which there is a cutting of about 150 feet wide and varying in depth from eight to fourteen feet. In the blasting of this rock about one ton of dynamite is used a day, and about two car-loads of coal are consumed every day, in operating the plant. The company expects to be in a position to deliver power May 1st. J. Aylen, C.E., is in charge of the works. Thos. Lyndsay, Ottawa, is president of the company.

The Niagara Falls Park Commissioners have reached an agreement with the Fort Erie Electric Ry. Co., under which the latter will be allowed to extend its line for a distance of thirteen miles along the bank of the Niagara River to Slater's Point. This brings the line within two miles of Chippewa, but the ground between the two points is already occupied by the Niagara Falls Park and River Ry., which did not run cars between Slater's Point and Chippewa last season, and the Park Commissioners may cancel the existing agreement and transfer running rights to the Fort Erie Company. In return for the franchise from Fort Erie to Slater's Point the Fort Erie Co. has agreed to buy a right of way, giving a width of 66 feet over the land to be traversed, and to pay a yearly rental.

A recent report respecting the good understanding which is known to exist between the Royal Electric, the Chambly Water and Power Company, and the Montreal Street Railway, is that the latter corporation will buy large blocks of the Water and Power Company's stock. It is also said that the Royal Electric will buy a large interest in the same corporation. It is a well-known fact that the Montreal Street Railway will take a good share—if not all—its power from the works at Chambly, and it is generally believed that between the Street Railway and the Royal Electric, the two consumers of electricity will be able to use up about all the power that the Chambly Company can furnish. The officials of the different companies, while not denying that there are plans on foot, refuse to say anything at the present.

Marine News.

A marine railway is building at Parrsboro, N.S., this winter; local capital having been subscribed.

Innes, Hemeon & Co., general merchants, shipbuilders, etc., Liverpool, N.S., are applying for incorporation as Innes, Hemeon & Co., Ltd.

The Montreal Harbor Commissioners have empowered the chief harbor engineer, John Kennedy, C.E., to prepare estimates and specifications of a powerful dredge, a derrick and four scows, for use in the harbor improvement works next summer. It is estimated that this additional plant will cost about $100,000.

There is a considerable revival of wooden shipbuilding in Nova Scotia, notably at Parrsboro' and Port Greville, where a number of four-masted schooners are being built.

Adam Mackay, Hamilton, Ont., who has returned from England, says the two new boats being built for the Hamilton and Fort William Navigation Company will be ready by June 1.

The Davies Dry Dock Co., shipbuilders, Kingston, Ont., have the contract to build a steamboat, 70 feet long, for a Rat Portage firm. It will be completed in time for the opening of navigation.

The new wharf to be built by the Richelieu & Ontario Navigation Company at the foot of Scott street, Toronto, will be completed by the 1st of April, and will cost $23,000. The wharf will be 357 feet long and 54 feet wide. On it will be erected freight sheds, waiting rooms and ticket offices for both the Hamilton Steamboat Line and R. & O. Company.

R. J. Leslie, Halifax, N.S.; J. McLean, Souris, P.E.I.; William McKenzie, Pictou, N.S.; E. G. Kenny, Halifax, N.S.; J. G. Binet, Magdalen Islands, Que.; G. C. Hart, Halifax, N.S., and W. G. Leslie, Magdalen Islands, are applying for incorporation as the Magdalen Islands Steamship Company, Ltd., with a total capital stock of $100,000, headquarters at Halifax, N.S.

Railway Matters.

The pension system recently introduced by the Pennsylvania railways is taking root on the other lines.

The Quebec Central Railway Co. gave its office employees a raise of ten per cent. on their salary as a Christmas present.

The Mineral Ry. Co. asks a charter to build a railway from Gros Cap Harbor on the north shore of Lake Superior to the Canadian Pacific Railway.

It is said that the Canso and Louisburg Railway Co. is contemplating the construction of a bridge across the Strait, which, it is estimated, will cost $3,000,000.

The Montreal and Ottawa Railway Co. is applying for an Act extending the time within which it may complete its railway and connect it with the railway of the C.P.R. in Ottawa.

The Canada Atlantic Railway Co. intends building a second elevator at Depot Harbor, Ont., with a capacity of 1,500,000 bushels, this season. It will also add three new steamers to its grain fleet on the upper lakes.

Incorporation is asked for the Crow Lake Railway and Development Co., to construct a railway from White Fish Bay, Lake of the Woods, easterly to a point in Crow Lake, and to operate same by steam or electricity.

Application will be made for incorporation of a company to construct a railway from near Cascade, B.C., in a westerly direction to Carson, with a branch from Grand Forks fifty miles up the North Fork of the Kettle River, following the valley of the same river, also with a branch from a point at or near Grand Forks in a southwesterly direction by way of Greenwood, to Midway.

The Manitoulin and North Shore Railway Co. will apply to the Ontario Legislature at its next session to empower it to build from Little Current to James Bay, and from the township of Drury to Sudbury, and also from Little Current to the south shore of Manitoulin Island, and from Tobermoray in the county of Bruce to Meaford, passing through Wiarton and Owen Sound, Ont.

The Athabasca Central Railway will apply for a charter at next session of the Dominion Parliament to build a railway from Edmonton to Victoria Settlement and the Athabasca River, and on to Vermillion Falls on the Peace River. The company will also ask power to mine, smelt and manufacture iron, etc., and develop asphalt, gas, tar, and petroleum deposits, and do a general trading business in lumber, etc.

Application will be made to the Ontario Legislature for incorporation for the Wabigoon, Manitou and Rainy Lake Railway Co. to build a steam or electric railway from the south-eastern end of Minnetakie Lake or Mine Centre, and from a point on the Canadian Pacific Ry. between Dryden and Tache

Station, southerly (east of Manitou Lake), to a point on the Ontario and Rainy River Railway between Fort Francis and Sturgeon Falls.

Application will be made at the next session of the Dominion Government for a charter for a company to construct a line of railway from Collingwood to Toronto, Ont., and also to maintain a fleet of vessels to run between Toronto and the River St. Lawrence. W. Mortimer Clark, Q.C., is the solicitor for the applicants, the names of whom have not as yet been made known. Mr. Mortimer Clark says there is plenty of money in the company, which is composed of financial men The new railway will do a grain-carrying business principally.

Application will be made to the Ontario Government for the incorporation of the Crow Lake Railway and Development Company, with power to construct a railway from a point on White Fish Bay, Lake of the Woods, to a point on Crow Lake, and to operate same by steam, electricity or other motive power, also with power to build and operate steamboats, saw mills, electric power plants, hotels, stores, wharves, milling plants, and to operate and develop mines, and to obtain the exclusive privilege of carrying on the business of fishing in Crow Lake.

The Dominion Iron and Steel Co. propose to construct a line of railway from its quarries at George's River, to connect with the I. C. R. about midway between the George's River station and the North Sydney junction. Grading has already commenced, and it is anticipated that early this month, when the stone crusher and compressor are expected to arrive, the company will be in a position to ship material over the new line to the works here. A bridge will span the river opposite the quarries. Martin Stephens, of Belle Isle, Nfld., has been appointed manager of the quarries.

Mining Matters.

T. B. Caldwell is developing extensive water powers at his iron mines at Calabogie, Renfrew county, Ont.

It has been announced that the Slocan, B.C., miners have accepted the Payne's offer of $3.75 per day of eight hours.

The expenditure of the Dominion Coal Company in Nova Scotia exclusive of royalty and wages is about $600,000 annually.

The big shafts being sunk by the Dominion Coal Company, near Glace Bay, C.B., are down, air shaft 100 feet and main shaft 130 feet.

A great boom in copper development is predicted by M. H. Fitzpatrick, Pictou, N.S. The Crown Copper Co. is making great progress.

Very extensive discoveries of hematite are reported from Visso's Ridge, near Portugal Cove, Nfld. The ore is similar to that at Belle Isle.

There have been fresh discoveries of petroleum in Cape Breton at Lake Ainslie. A flowing well was recently struck at 565 feet, the Sydney Record says.

The Lake Superior Mining Institute will hold its next meeting at Iron Mountain, commencing 6th February next. The secretary is F. W. Sperr, Houghton, Mich.

The prospectus of the Sultana Mine of Canada, Ltd., states that the mine was bought from J. F. Caldwell, Winnipeg, for £225,000, all of which Mr. Caldwell took in stock.

Natural gas was struck in the Queen Victoria Park at Niagara Falls, Ont., where test borings were being made preparatory to calling for tenders for the power tunnels.

A. E. Martin has discovered extensive veins of graphite running from 35 to 50 per cent flake graphite on the farm of O. McCoy, on the River Blanch, St. Malachy, Que. There is said to be a fine water power in the neighborhood.

Great activity is noticeable in mica mining in the Gatineau River district, particularly in Hull, Wakefield and Templeton townships. The Blackburn Bros., Wallingfords, Sills Mica Co., A. H. Murphy, and a great many smaller operators are producing large quantities.

The prosperity in the iron industry has directed renewed attention to the iron resources of Quebec, and it is likely that the Bristol, Old Ironsides and Haycock mines in Ottawa county, which have been shut down for a number of years, will be reopened shortly.

The Crown Copper Company expect to have their furnaces in operation in about four weeks or sooner. The engine is up and has been tested. A powerful dynamo has been set up, and the wiring of the large buildings is going forward.—Mining Record, January.

C. E. Mitchener, M.E., New Philadelphia, U.S.; C. H. Howland, Cuyahoga Falls, O.; H. Totten and N. F. Davidson, Toronto, Ont.; and W. McVittie, Sudbury, Ont., are applying for incorporation as the Canadian Nickel Co., Ltd.; capital to be $900,000; head office, Worthington, Ont.

It is understood that by the opening of spring arrangements will have been completed for the construction of a silver-lead smelter at Moyie Lake, B.C. Both furnaces at the Hall Mines smelter at Nelson are in blast. The one hundred ton furnace is running on lead ore, and the big one on Silver King ore.

At Thetford, Que., the Bells Asbestos Co., King Bros. and Johnsons are the principal operators in asbestos. At Black Lake mining has been resumed by the Glasgow and Montreal Asbestos Co. The property formerly worked by the American Asbestos Co. is now known as the Union Mine and is being worked by a German company.

The Mikado Mining Co., of which T. R. Deacon, C.E., of Rat Portage, is the Canadian director, has just installed a sorting plant in their 20 stamp mill at the Mikado mine near Rat Portage, in order to increase the efficiency of their present batteries. By this means it is expected that the output of bullion which has been running about $12,000 per month, will be increased, as there is plenty of good ore in sight.

J. Patterson, J. Moodie, W. Southam, C. W. Moodie, J. R. Moodie, J. M. Harris, S. Barker, W. W. Osborne, J. J. Scott, J. Dixon, A. T. Wood, T. H. Macpherson, J. T. Glassco, J. Knox, J. H. Tilden, J. Milne, G. E. Tuckett, H. B. Witton and J. W. Sutherland, Hamilton, Ont., and J. A. Kammerer, Toronto, have been incorporated as the Nickel Copper Co., of Ontario, Ltd.; capital, $10,000,000; head office, Hamilton. The company proposes to carry on in all its branches, mining, milling and reducing.

Mining industries are still attracting attention in the vicinity of St. Stephen. The English syndicate is working on its shaft on the Hall farm. The ore is looking well. Another company is now at work near Moore's Mills getting ready to sink a shaft. They claim to be on the same nickel ore that crops out on the Hall farm. Still another company, a Boston syndicate, will soon operate on the Magguerrock Mountain claim, on the American side of the river, above Milltown. It looks as if there would be quite a mining boom on the St. Croix in the near future.—St. John, N.B., Telegraph.

News was brought by the steamer "Danube," from Skaguay to Vancouver, December 19th, of the reported discovery of a vast body of free milling ore, within ten miles of Dawson. The Yukon Sun says it is one thousand feet in depth, one mile wide, of unknown though great length, assaying as high as $860 to the ton. Over twenty claims were recorded in that locality up to November 7th. The exact location of this ore body is given as the left bank of the Yukon, seven miles above Dawson. It is neither a deposit of gravel nor a quartz ledge. As defined by a Dawson metallurgist, it is an oxidized mass of quartzoric porphyrite rock, containing more or less gold throughout the porous oxidized material, as well as in hard quartzite.

S. J. Ritchie, Akron, O., has begun a suit for $1,200,000 damages in the Common Pleas Court against Stevenson Burke, N. P. McIntosh, C. W. Bingham and the other directors of the Anglo-American Iron Company. Mr. Ritchie, who originally discovered valuable deposits of mineral in the Sudbury district of Ontario, has been in constant litigation for years with the Cleveland capitalists who were interested with him in developing the field. The suit filed January 13th, alleges that the defendants are in the control of the Anglo American Iron Company, who also control the Canada Copper Company, which has properties in the same neighborhood; they have neglected and refused to

operate the mines and mills of the former company, while pushing the property of the latter. The Anglo-American Iron Company, he says, could earn $300,000 a year, and he asks the judgment in behalf of all the shareholders, except the defendant directors.

MEASURES AND RULES.*

BY P. TROWERN.

Before I enter on fractions or decimals I would like to tell you how the mechanics' rule was brought into use (our foot rule I mean). A long time ago measurements of land were made by a person stepping it, one foot before the other in a straight line, which were called so many steps by the land surveyor, and the small pieces were measured by their feet, the heel of one foot touching the toes of the other, which made it so many steps, and feet disputes soon arose between the people and the surveyors so that the Government had to make laws for the people, and in 1760 a number of men's feet were measured, and they came to the decision that a step should agree with 3 feet, called a yard, and that a foot should be divided into 12 equal parts, called inches, so you see the yard became a unit, and a foot was 1-3 of a yard, a fraction or piece, and the inch, 1-12 of a foot, became a fraction, or a small part of the 36 inch yard; a gold rod was made and marked off in feet and inches as a standard belonging to the Government in England. All countries do not agree with regard to the length of the foot; 46 French feet is equal to 49 English, 35 German feet are equal to 57 French; the Russian foot is equal to the English foot, the old Turin foot was equal to 20 inches, and the inch was divided into 12 parts; in all the Prussian States the length of the foot differed; the inch in England and Canada is divided into 8 parts to commemorate or keep before our eyes or knowledge the very useful and mechanical members of our bodies; our two hands and arms, our two legs and feet, equal 4 or ½ inch, and our two eyes and our two ears make the 8 parts, or the vulgar fractions; this word was not then used as it is now, but to show the parts of the whole unit, the yard. The French said that we have as great a national right to show our love and respect to our five fingers and toes as to any other part of our body, which induced them to divide their foot into 10 parts, and their inches into 10 parts; by so doing they brought into general use among themselves the decimals, 5 on one hand and 5 on the other, equal 10, and 10 toes equal 20, and this $20 \times 5 = 100$, which they called a unit; this unit x by $10 = 1{,}000$, and so on. I will now draw your attention to the fractions of our 12 inch rule; we say so many feet, inches and eighths; what I conceive it to be our duty in this society is to keep before our mind the use of our rule and calculations of our foot rule; if you wish to practise fractions make your calculations with the different fractional parts of it, keeping before you our mechanic's rule as a unit; ½ of 12 inches equals 6, ¼ equals 3, 1-12 equals 1; the division of the 1 inch are vulgar fractions, ½ of an inch equals 4-3, ¼ equals 2-3 and ½ equal to 1 of the 8 parts the inch is divided into, or if you wish to divide it more, 1-16, 1-32 and so on, and to have mixed fractions you may say 1 foot 3 inches and ⅞ and a 1-32; and if you wish to add a number of them together it is easily done.

In 1788 the French people asked their Government to have a standard by which all their weights and measures might be made and compared. A number of scientific men were called together to devise a standard, which they did by taking a fourth part of a meridian of circumference of the earth. This fourth part of the line was divided into 10,000,000 equal parts, and each part was called a metre, which is equal to about 39 English inches; this metre is divided by 10, and called a decimetre, and by 100 and called a centimetre, by 1,000 and called a millimetre. To obtain the other measures a cubical box was made, exactly on each of its sides 1 100 part of a metre, or one centimetre; this was filled with water at its greatest density, and the weight of this water was called a gramme; a gramme was divided by 100, and it was called a centigramme.

*From a paper read before No. 1 C. A. S. E.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain of interest to the metal trades for the month of December and the twelve months ending December, 1898-99.

	Month of Dec.		The year to December.	
	1898.	1899.	1898.	1899.
Hardware	£1,278	£2,299	£21,578	£21,69
Cutlery	2,831	4,102	51,374	53,795
Pig iron	42	2,043	11,043	38,366
Bar, etc.	1,429	1,133	10,478	34,061
Railroad	12	100	9,195	152,981
Hoops, sheets, etc.	1,627	1,282	63,605	111,653
Galvanized sheets	623	322	65,176	69,515
Tin plates	13,090	14,043	168,627	249,513
Cast, wrought, etc., iron	2,182	5,892	26,820	67,783
Old (for re-manufacture)	—	683	4,324	8,408
Steel	2,282	17,149	48,844	157,504
Lead	1,041	1,277	36,092	44,855
Tin, unwrought	759	1,979	16,601	25,922
Alkali	1,705	2,332	50,028	44,656
Cement	487	449	25,595	38,749

ONE FIRST-CLASS MARINE BOILER

Eight feet long, 4 feet 8 inches wide, 86-2½ tubes, 6 feet long. Allowed 115 lbs. steam. Been in use 4 years. DAVIS DRY DOCK CO., Kingston. 2-1

FOR SALE

Canadian Patent Rights in **Meter for Recording the Volume of Water and Power** used by hydraulic power plants. Correspondence solicited.

C. P. RUTTY, 742 Prudential Bldg., Buffalo, N.Y. 2-1

FOR SALE

A good Water Power, 500 horse, situated one-half mile from railway, every facility for making siding to power. Address

J. D. THEUNISSON, Cookshire, Que.

Bridge Tenders Wanted.

Sealed Tenders (marked tenders for bridge) for the superstructure of a steel bridge over the South Nation River at Lemieux, on the boundary line between Prescott and Russell, Ont., will be received by the undersigned up to the 20th January next, inclusive (1900).

Separate Tenders for the construction of the "abutments" of said bridge will be received by the undersigned up to said 20th day of January next, inclusive.

Plans and specifications of said bridge (iron work and masonry) may be seen and further information obtained, at the office of the undersigned, in the Court House in the Village of L'Orignal.

The lowest or any tender not necessarily accepted.

E. ABBOT JOHNSON,
Clerk United Counties of Prescott and Russell.

L'Orignal, December 12th, 1899.

ST. LAWRENCE CANALS

NOTICE TO ENGINE AND BOILER MAKERS.

Sealed Tenders addressed to the undersigned and endorsed "Tender for Engines and Boiler," will be received at this office until sixteen o'clock on Monday, 5th February, 1900, for the construction, &c., of two non-condensing marine engines and a Clyde boiler.

Specification of the work can be seen at the office of the Chief Engineer of the Department of Railways and Canals at Ottawa, and at the Superintending Engineer's Office, Corn vall, where forms of tenders can be obtained on and after Saturday, 20th January, 1900.

In the case of firms there must be attached the actual signatures of the full name, the nature of the occupation and place of residence of each member of the same, and, further, an accepted bank cheque for the sum of $500 must accompany the tender; this accepted cheque must be endorsed over to the Minister of Railways and Canals, and will be forfeited if the party tendering declines entering into contract for work at the rates and terms stated in the offer submitted. The accepted cheque thus sent in will be returned to the respective parties whose tenders are not accepted.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES
Secretary

Department of Railways and Canals,
Ottawa, 18th January, 1900.

Newspapers inserting this advertisement without authority from the Department will not be paid for it. 2-1

The Canadian Engineer

VOL. VII.—No. 11. TORONTO AND MONTREAL, MARCH, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR, R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE

Toronto Telephone, 1392. Montreal Telephone, 2589.

PHILADELPHIA AGENT: H. E. BURNETTE, 2036 N. 13th Street.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Canadian Society of Civil Engineers	294
Canadian Association of Stationary Engineers	301
Clutch Arnold Magnetic	302
Coal Seams, Notes on the Deposition and Development of the Glace Bay	305
Cranes, Electric Travelling	302
Compounds, The use of Boiler	307
Dominion Estimates	301
Engineers' Club, The Toronto	301
Electric Flashes	309
Engineering Company, General, vs. The Dominion Cotton Mills Co. and American Stoker Company	306
Industrial Notes	308
Literary Notes	312
Marine News	310
Metal Imports from Great Britain	304
Mining Matters	311
Nickel-Steel, Canadian	292
Nickel-Steel, The Properties of	304
Patents, Canadian	312
Peat as Fuel in Canada	292
Railway Matters	312
Readers, It Benefits	306
Red Cross Fund	307
South Africa, Its People and Trade	291
Surveyors, The Ontario Association of Land	304
Surveyors, New Land	306
Toronto, The Muddlers build again	293
Technical, The Toronto School	312
Trap, The Interception	289
Victoria Hospital, London Ont.; The Electric Lighting and Power Plant of	300

THE INTERCEPTION TRAP.

BY W. M. WATSON.

For THE CANADIAN ENGINEER.

About forty years since I began to learn the sanitary trade, many private drains were built with rough stone, bricks, broken pipes and wood; they were totally void of any scientific arrangement or rule; no regard was paid to grading, and often the level turned the wrong way, which of course made the channels useless as carriers of sewage. Such private drains only distributed the poisonous sewage among the subsoil of the premises they were laid under, making the ground a cesspool of impurities that generated foul gases and contaminated the living rooms of the dwellings.

This state of things caused an appalling death rate among young children, who spent most of their time in such polluted atmospheres. To add to the leaky and unsanitary state of such private drains it was only in a few of the best plumbing jobs that either the soil pipe, the waste pipe or the head of the drain pipe line, was continued upward to above the house roof with a view of ventilating the plumbing, the private drain line and the public sewer.

To have cured this defect was simple enough, by having the drains laid with good sound pipes, tightly jointed and scientifically laid by competent workmen, and the terminating head of every drain, soil pipe and drain pipe carried up to above the highest point of the roof of the building, so as to ensure a good circulation of air from the street sewer upward through the line of pipes. However, the usual methods of tackling such difficulties was adopted. Professional engineers and scientists made a big thing out of the sanitary cow, and meetings and lectures were many, to make a remedy for so serious an evil, and the result was that W. P. Buchan, Glasgow, got the pull and inaugurated the system in 1872 of placing an interception trap in all private drains at a point where the private drain entered private property, or buildings. His argument was that no poisonous sewer gas could pass from the public sewers to the private house, if this shut-off valve or interception trap was fixed into the private drain; but he took no note of the fact that the putrid matter that poisoned the dwelling was under the dwelling, and not in the street sewer at that time, and if the street sewers were so badly laid that they generated poisonous microbes, the very best way was to provide plenty of means to draw off the foul gases to a point of the atmosphere above the house tops, where they would at once die, for dangerous microbes can live only where there is no circulation of air, and no better carrier of air or gas can be found than the warm moistened walls of a sewer or soil pipe.

Our Glasgow friend no doubt was a thinking man, but he evidently was not sufficiently well informed to know that when public sewers are scientifically laid, they are self-cleansing and self-aerating. When that is accomplished the sewage is kept moving until it reaches the sewage outfall, on that ground the foul matter entering the sewers cannot breed or incubate microbes, nor generate foul gases of any kind, because such putrefaction can only take place in very sluggish streams and cesspools, two things that are not admissible in a well laid drain. Then with regard to aeration of the sewers, if both the sewers, the private house drain, and the plumbing be scientifically designed, and worked out, every pint of sewage discharged from the house fixtures into the drain will carry with it into the main sewer about one quart of fresh atmospheric air, about sufficient to clean out and purify it. When the time arrives that a reasonable amount of common practical knowledge is used when constructing sewer drains and plumbing, the sewers themselves will do a great deal towards cleaning and purifying, by the help of bacteria, the foul liquid that is put through them. The system of Mr. Buchan prevents all this good work by placing the interception traps on all private drains, because the drains cannot have the proper and natural ventilation, nor can the sewage carry air into the sewers; moreover the sewers cannot be self-cleansing, in fact, it turns the whole system of sewers into a poisonous gas making machine, that has already sent many to a premature grave and will send many more before the fad works itself out.

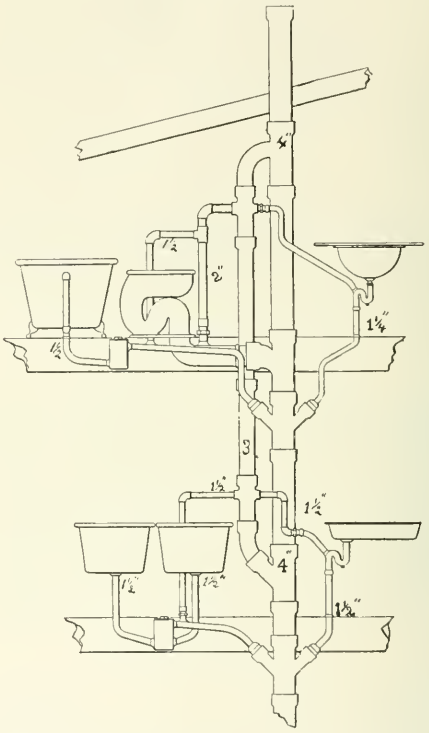
The time is ripe for reliable statistics to be published showing the sickness and death rate of the inhab

itants living in houses having the interception trap on their drains, and similar houses that have not, so that the public would be enabled to judge for themselves whether or not it is a dangerous innovation. Though this would only show a small part of the danger and the injury done, because the whole sewage system of the town is fouled for the want of the ventilation which the interception trap prohibits.

The introduction of the interception trap has given sanitary theorists a large field wherein they have introduced many kinds of machines to try and aerate the drains, and flush the sluggish sewers, and by so doing prevent the generating of foul gases, but at every point they have met with poor success, and many of the public streets are charged with foul odors coming from the sewer manholes, and people living in elevated places where the town sewer gas is driven have often to suffer contagious illnesses, simply because the town sewers are not ventilated by natural principles, or in other words let me say that nature is not allowed to perform her appointed duty; if it was, then the making of obstructions in the flow of sewage and sewage aeration would cease. Sewage ventilation would be fully secured by using the simple and natural means that is at hand when the interception trap is left out. To do this all private drains must be inserted in the crown of the street sewer, and continue on a rising grade free from any obstruction until the line arrives above the roof of the building, and all the waste pipes of all the conveniences on the premises must be connected with the vertical soil pipe separately by a short branch and trap.

There are more injurious excesses and unscientific obstructions placed in the sewage and plumbing appliances at the present period, than I have ever witnessed during my forty years' experience, and these excesses are as expensive as they are useless, and many of them are dangerous to the public health.

Fads being catching it is only the excessive cost that has prevented many councils from destroying their present system of ventilation by compelling their townspeople to adopt the interception trap principle in their house drains. To show the excess that plumbing has arrived at I ask the reader to study a drawing of R. M. Starbuck's, published in The Sanitary Journal of New York, which is a fair drawing, showing how plumbing must be put together in many cities and towns which consider their sanitary business the acme of perfection. The drawing shows at least twice the amount of pipes and joints that are necessary to make safe and first-class sanitary jobs that will work freely. It also shows the waste pipes from the conveniences to be arranged and carried out to the soil pipe connection in a way that cannot meet with approval of an expert experienced plumber. There is too much pipe used, and it is not well arranged. I gave sketches, and the reasons for making this remark in my article on plumbing in February issue of 1869 and September issue, 1868; these two articles give detail reasons for several assertions made in this paper. The 3-inch main line ventilation pipe shown to be joined by a branch to the 4-inch soil pipe near the washtubs, and again at a point just under the roof, cannot have any circulation of air, for no current passing up the soil-pipe can be made to branch off and return into the soil-pipe again without the use of force. It is possible to turn the air round the 3-inch by-pass, by placing a stop valve in the 4-inch soil pipe, somewhere between the two 3-inch branches, but by no other natural way, so we can safely say that the so-called 3-inch ventilation pipe, together with its five branches that lead to the five different conveniences, are no ventilation pipes at all. The only office they can perform is to form a relief, so that when the contents of the pipes contract or expand they will throw out, or take in the small quantity of air needed to balance the space.



But there is another duty that they are credited with performing, viz., they prevent the key of water (that forms the air valve in all traps), from being syphoned out. When plumbers arrange the waste pipes from the bath and sinks in the way they are shown in this sketch, they do their level best to coax the traps that serve the fixtures to be syphoned, but there are reasons why they never do syphon, when used in the usual domestic way, they never did syphon nor they never will, but if the waste pipes were connected to the soil pipe in a proper mechanical way, they could not be syphoned, if every pipe, including the soil pipe, was running full bore at one flush, which is an action that can never happen in the usual way of using them. Experiments have been repeatedly made, and the results have shown that such vent pipes are no use, but on the other hand do much harm, and are responsible for many premature deaths; this, too, has been personally proved.

The oldest plumber never found a trap on a house pipe dried out by evaporation before the fad of venting all traps was introduced, because the drying influence of the atmosphere on the house side of the trap was balanced by the condensing of the sewer air and moisture present on the sewer side of the same trap. When a vent pipe is connected to the sewer side of the trap it

abolishes the moisture feed that the trap formerly had, and applies another drying influence into the traps, so that evaporation is going on both on the house and sewer side of the water seat, that is lodging in the dip of the small trap, therefore, it is only a matter of a few hours for the seal of the bath trap to become broken, and a passage is then open to introduce the gas from the sewers into the sleeping rooms, and it is by this method that some of our best houses have diphtheria and typhoid.

It may be safely said that where one trap can be found with its seal broken, because it has been syphoned, fifty traps can be found that have had the seal broken and dried out by evaporation, caused by the air coming in contact with the water on both sides of the trap, and on account of having a ventilation pipe placed on the sewer side of the trap, as has been shown.

SOUTH AFRICA, ITS PEOPLE AND TRADE.

CAUSES OF THE BOER WAR.

ARTICLE V.

(Continued from last issue).

A word as to the commercial situation. In the year 1884 the revenue of the Transvaal was £161,596, and the expenditure, £184,820. The population at that time was about 45,000, of whom 35,000 to 37,000 were Dutch. That was the year when Kruger went to England to obtain the new convention. The finances of his country were in bad shape, and remembering what England and Englishmen had done to rehabilitate the country financially during the three years of British administration, he had a letter published in the London papers inviting British capitalists, miners and merchants to come and settle in the Transvaal. They accepted the invitation, and in 1885—86 the De Kaap and Witwatersrand fields were discovered, with the result that the revenue for 1898 was £3,329,958, practically all of which is derived from the energies of the Uitlander. In the face of this, Kruger now asks, and the pro-Boer organs throughout the world echo the question: "If the Uitlander does not like the treatment he gets, why does he not stay away?" The Uitlander, upon Kruger's invitation, came to the country, discovered the gold, and built up the industry. Should he be robbed of the business he has created? And if prior occupation is urged by the Boer, how about the Kafirs, whom he has dispossessed of their lands? But while an unnecessary revenue, such as this, is squeezed from one element of the population, the expenditure has gone on to keep pace with it. This year the civil service list amounted to £1,216,294, or enough to give £40 to each male inhabitant of the country. The ordinary expenditure last year was £3,476,844. A large part of this, as stated, goes to build up a military power to overawe and oppress the very people whose exertions provide the money; much of it, according to Cecil Rhodes, has gone as a bribery fund to influence elections in the Cape Colony, and carry on the propaganda for seducing the Cape Dutch from their allegiance to Britain. A huge secret service fund* is used largely for political purposes in Europe to the same end; while a large but unknown sum is given by the President himself, as "doles," to Boers in the back districts, ostensibly to help farmers in distressed circumstances, but in reality to keep burghers loyal to him. The various monopolies also yield large bribery funds. The dynamite monopoly, by which the sole right to make or sell dynamite was given to one man (afterwards a syndicate), who was permitted to charge 200 per cent. over what the article would cost in the open market, filches from the Witwatersrand mines alone £600,000 a year. Space forbids reference here to the other monopolies, but it may be noted that these monopolies are given to Kruger's favorites on articles that are chiefly imported from Great Britain, or are used chiefly by British subjects. This is one of the numerous violations of the conventions, which provided that the taxation should be equal to all classes. It may also be noted that President Kruger has not only defended these monopolists under all circumstances, but in the numerous cases in which boodling schemes have been unearthed, and scandals exposed —sometimes by honest men in his own party—he has invariably shielded the boodlers and not infrequently promoted them or given them fresh opportunities.

A great deal might be said on the external relations of the Transvaal. The convention of 1884 fixed the boundaries of the Transvaal exactly, and the republic undertook solemnly to respect the independence of native chiefs outside its territory. Scarcely a year has passed without the violation of the convention in this respect. One of Kruger's first acts was to invade part of the British Protectorate and proclaim it a portion of the Republic, following up the operations of some of his free booters. And he only withdrew because of Mr. Rhodes' protest and the Warren expedition, which cost the British Government over £1,250,000. Then the Boer Government turned its attention to Zululand, which, after an intrigue with Dinizulu against the other chiefs, it invaded and attempted to upset the settlement made by Lord Wolseley. Next they invaded the country of the Matabele whom they had driven out of the Transvaal originally, and who were now under British protection, and they were only turned back by the tact and firmness of Dr. Jameson. Again they tried to lay hands on Tongaland, but the Queen Regent would have nothing to do with any country but England, whose protection she had sought. The invasion and spoliation of Swaziland was another Boer outrage, which Great Britain, from a mistaken notion of keeping peace with the Boers, condoned.

Such are a few of the features of Krugerism in South Africa, and the reader can judge whether they are such as to justify the interference of Great Britain.

It is a subject of wonder to many that the Boers persist in a course which a large number of them must know to be wrong, and stand out against the whole might of the British Empire in so doing. It must be remembered, however, that the vast majority, who never read a newspaper, or a book, except the Bible, are as ignorant of the outside world as the Hudson Bay Indians. Perhaps not ten of the whole body of burghers ever saw a man-of-war or visited England or Europe. Even Kruger and the other members of the Volksraad, who visited England, saw little of its resources; and it must be admitted of Kruger, who is a man absolutely without fear, that if he had the clearest realization of Britain's power, it would make no difference with his policy, so convinced is he that the Boers are the only favored nation of Heaven. What can be

done with a man who believes (as Kruger argued with Dr. Hertz, and a deputation of Johannesburg Jews, who came last year to plead for educational freedom), that the Boers are the direct descendants of Isaac, and the Jews the descendants of Ishmael, and that, therefore, it would be against the Scriptures for both people to inherit the land together! It must also be understood that, whatever the Boer leaders know, the Boers themselves are convinced that when the Gladstone Government gave back the country in 1881, it was through fear, and that the profession of generosity or justice was merely a cloak for this fear. And they point, in confirmation, to the fact that when Mr. Gladstone, after denouncing the annexation, in his Midlothian speeches in Opposition, came into power, he refused all along to restore the Boer Government until he had the experience of Majuba Hill. The leniency with which the British Government treated the Transvaal in its repeated violations of the two conventions, and the way in which they were allowed to despoil the Swazi tribe, were to the Boer mind only so much accumulating evidence of this fear, apparent to him as the years went on. Perhaps Kruger himself thought the Transvaal was a match for Britain, as J. P. Fitzpatrick relates the following, in his "Transvaal from Within:" "The late W. Y. Campbell, as spokesman of a deputation from Johannesburg, addressing President Kruger, stated in the course of his remarks that the people of Johannesburg 'protested' against a certain measure. The President jumped up in one of his characteristic moods, and said: 'Protest! Protest! What is the good of protesting? You have not got the guns! I have.' And Mr. Campbell, in reporting this in Johannesburg, remarked: 'That man is sensible; he knows the position. I claim to be sensible, also, and I know he is right; you can take my name off any other deputations, for we'll get nothing by asking.'"

We have evidence that several members of the Raad would have given the Uitlanders, not all, but some of the rights they vainly sought, but Kruger had become too powerful an autocrat, and they were no match for him either in diplomacy or determination. But though the Boers were ignorant, they were not so ignorant as to fail to realize that if the franchise was granted to Uitlanders, and a clean, honest administration inaugurated, these "doles" to burghers would cease, and they would no longer be able to live in ease at the expense of the hard-working alien. Hence, their determination to do what would otherwise appear insane—to risk the destruction of the Republic itself rather than to do justice at the cost of giving up control.

(To be continued).

CANADIAN NICKEL-STEEL.

The nickel-steel age, spoken of by Prof. Roberts-Austin before the British Association for the Advancement of Science, as being the next great period in the industrial progress of the world, is now entered upon. The most learned metallurgist in the world, whose opinion we have just quoted, also predicted that Canada would take a leading part in the developments which would characterize that epoch. There is no reason why the nickel-steel supplies of the world should not come from Canada. We can make iron cheaper than anywhere else in the world. We have the greatest and cheapest nickel supplies, because Canadian nickel contains enough copper to pay for getting it out and treating it, therefore the nickel-steel can be produced by us at prices which defy competition.

Hamilton, Ont., is to be the seat of great metallurgical industries. To the iron smelter and rolling mills already there, is now being added the Hoepfner Refining Co.'s works, which will refine zinc, copper and nickel. To operate this plant 3,600 electrical horse-power will be required, which will be furnished by the Cataract Power Co. J. Patterson stated publicly on March 1st, that contracts had been made with the Canadian Nickel Company, the Nickel Copper Company of Ontario, and the Hoepfner Refining Company, for the refining of nickel matte, the contractors to supply sixty tons of matte a day to the Hamilton works. As soon as the Hoepfner Co.'s plant is an accomplished fact, which will likely be in the coming spring, the nickel-steel plant will be started, and the cost of the buildings and machinery will be about $6,000,000.

For THE CANADIAN ENGINEER.

PEAT AS FUEL IN CANADA.

BY A. G. ARDAGH.

Peat or turf is usually associated in our minds with the old home-land, but there are many who do not know that in our country we have peat bogs of similar character. Swamp land, as we know, is widely distributed in the Dominion, but the product is not recognized by old country people as turf, which is generally the product of mosses; of the latter there exists, nevertheless, large deposits in Ontario and other Provinces. Both kinds of peat can be utilized as fuel. These peats are decomposed mosses, sedges, aquatic plants and other vegetable matters. Dana says: "In temperate climates it is due mainly to the growth of mosses of the genus sphagnum. This plant forms a loose turf, and has the peculiar property of dying at the extremity of the roots below while it continuously grows and increases above the surface, and by this process a bed of great thickness is gradually formed." In "older" peat there are a few traces of fibrous matters, but it presents a pitchy, shining hue when cut. It will dry out more or less brown. In "recent peat" the fibrous condition is closely marked and the color brown.

In general the older peat is underneath, but the lower stratum may be immature peat. This is the case in the Ellice marsh, nine miles north of Stratford, Ontario, where there is a bed of several thousand acres of sphagnum peat about six feet deep. The moss has been burnt off the surface long since. On the great bog in the County of Welland a number of acres are still covered with the original sphagnum moss. It is curious that these marshes are usually to be found on the watersheds. Peat contains in undrained marshes about 90% of water. It parts with its water very slowly on exposure to the air when in the shape of bricks and out of contact with the bog. On the peat moors of Ireland, Scotland and Northern Continental Europe, turf has been, since time immemorial, cut out in brick form and marketed locally in its crude state, although previous to this many fruitless efforts have been made to compress it economically and on a commercial scale. In this way the

efficiency in burning power would be increased, the dust in handling and using avoided, and shipments to a distance could be easily made.

Peat ignites easily, requires practically no draught when once the fire has taken hold, gives intense heat, and a banked fire will not burn out nor will it go out until the fuel is consumed. It burns with a flame for some time, and then for a longer period in red hot coals. The gases emitted in the initial stages of burning are not only innocuous but considered by some medicinal, especially against lung troubles. The percentage of ash will vary with the deposit from which the peat is taken. The following analysis was made of samples of compressed fuel made from the product of the Welland bog with the moisture reduced to a suitable amount:

Moisture	12
Volatile matter	58.20
Fixed carbon	26.
Ash	3.80

The absence of soot, clinkers and practically of smoke (when burned under proper conditions) are qualities which will appeal to all classes of consumers. Peat in its crude state varies very much in weight—about 600 lbs. to the cubic yard may be taken as a fair density. The fuel as consolidated by the Dickson press will weigh from slightly under soft coal to slightly over hard coal, neither frost nor a damp atmosphere will affect it, but it should be protected from rain.

The Dickson Press, which is the result of many years patient experimenting, and the expenditure of a large amount of money on the part of the inventor, A. A. Dickson, of Toronto, commends itself by its simplicity. The peat, after being broken to a powder in a breaker, is disposed automatically by gravitation towards the lower and stationary dies or moulds, which consist of two steel tubes about twelve inches long, of uniform bore and open at both ends, into which work two punches. Each charge of peat which flows in when the punch rises is compacted into a solid block on the top of the previously made blocks which occupy the lower two-thirds of the tube, and this column of blocks is forced down a distance equal to the depth of the block made, and thus each time one drops out at the bottom. The resistance thus obtained is yielding, and the formative pressure is always the same. These ideas presented themselves to Mr. Dickson after the failure to press the peat in a closed mould, as this substance offers more resistance and friction in a dry, cold, and disintegrated state than any other natural ligneous substance known; Processes which involve the consolidation of the crude peat in a wet or hot state leave it subject to disintegration upon drying or cooling.

It may be interesting to know that during the past summer factories have been erected at the following places in Ontario: Kirkfield on the Trent Valley Canal, Picton, Perth, Beaverton, Brockville, Galt, Barrie, and on the Ellice marsh north of Stratford, to manufacture compressed peat fuel with Dickson presses. It has been largely an experimental year in many ways. Some of the factories have not yet run, but the fuel placed upon the respective markets in small quantities has been very favorably received, and large factories would be required to meet the evident desire of the public for the fuel. Although much can be accomplished by natural drying in the wind, the question of artificial drying is being speedily and satisfactorily solved, as the Trent Valley Peat Fuel Co. has installed a Cummer Dryer, which promises to render their manufacturing in a much larger degree independent of the weather. There are several other dryers to be installed elsewhere. Although for perhaps several years the fuel will be largely consumed domestically, yet as a steam-rising fuel it has proved its worth unequivocally.

The process of excavating and drying the peat as performed on the Ellice marsh last summer was as follows: Trenches were staked out 3′ 8″ wide, and at intervals two men, side by side, were set digging with the ordinary steel spades with lifting handles. The peat was dug out one spading deep at a time and spread along the bank, when this was dry on one side it was stacked in small stooks of four or five with the wet sides out, three or four pieces on end and one on top. Subsequently these stooks were gathered into larger piles to make way for the spreading of a second spading and so on. To gather in the dry peat, portable tracks were laid over the ditches and the peat thrown into trams carrying from ¾ of a ton to one ton and conveyed to sheds or huge stacks to be thatched with lumber or moss.

The use of dredges and other machinery may reduce the cost of the operations up to this point. The peat will be either taken dry from the shed or dumped wet into the dryer. It will be pulverized before gravitating to the compressing machinery. It will be carried mechanically through all the processes before compression, and also from the machine to the railway car or store-house.

THE TORONTO MUDDLERS BUILD AGAIN.

The people of Toronto are about to spend money in printing the city by-laws. So far as concerns codifying and printing the building by-laws, the money would be better spent in publishing them in the daily papers, so that the people might notice that they are entirely without protection from many of the dangers which threaten the city dweller from the incapacity or crime of those entrusted with building operations, either as owners, architects, or contractors.

We showed, in a former article, that the building regulations of Toronto were a farce, and the office of building inspector a sinecure. The daily papers republished our statements and commented upon them, but no action was taken. The by-laws, which no one knows anything about, and which are entirely inapplicable to present day building, are still supposed to be in force, but in almost all buildings on the business streets these by-laws are entirely ignored.

We will repeat one statement from our former article which shows, as no argument could, the position of affairs: "There are no rules for steel construction in the building regulations of the city of Toronto."

An example of how the building inspector in Toronto guards the public safety is shown by the fact that the city finds its new market building at a standstill, because the steel contractor has refused to erect the roof upon the brick piers provided by the city's architect, and of necessity approved by the building inspector, without whose approval nothing could of course have been done.

If the Dominion Bridge Co., the steel contractors, had gone on with the work, and it had fallen, as they

claim it must, the resulting damages against the city for loss of life would have been very heavy. There can be no doubt that the city is liable for damages to person and property for any accident arising in any way through a cause peculiar to the steel type of building.

If a steel girder in a Toronto building fail, no matter from what cause, the city is responsible because its presence in the building is not in accord with the city by-laws. Such buildings as house the large departmental stores in Toronto are most flagrant violations of the building laws of Toronto.

There are of course, rules for the building of kitchen chimneys, etc., and they are such as the fire underwriters enforce in the farm houses in Muskoka. It is a mistake for the good aldermen of Toronto to build a market; their business ability would find scope rather in growing cabbages which they might vend upon the city hall steps.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

FOURTEENTH ANNUAL MEETING.

The fourteenth annual meeting of the Canadian Society of Civil Engineers opened at the society's rooms, Montreal, on the 31st January.

The president, W. T. Jennings, of Toronto, occupied the chair, and there were present the following members: From Montreal, C. H. McLeod, secretary; Wm. McNab, librarian; H. Irwin, treasurer; J. G. G. Kerry, Geo. Hall, L. J. Marion, C. de B. Leprohon, Percival W. St. George, Frank T. St. George, T. W. Lesage, E. Marceau, E. Fusey, L. S. Pariseau, R. S. Lea, E. C. Amos, Geo. Holland, Alfred Dedman, E. Berryman, E. S. M. Lovelace, Lewis Skaife, R. Forsyth, G. H. Duggan, R. H. Balfour, A. E. Smaill, R. E. Hunter, G. L. Law, F. P. Shearwood, H. A Burson, E. E. Gagnon, E. A. Wallberg, W. J. Sproule, Prof. H. T. Bovey, F. E. Came, Herbert Wallis, J. W. Heckman, E. P. Hannaford, P. A. Peterson, Stuart Howard, W. McLea Walbank, Wm. Kennedy, L. J. Papineau, N. Hanson Greene, Arthur Crumpton, Geo. Janin, John Kennedy, Duncan MacPherson, John R. Barlow, J. S. Vindin, L. A. Desy, Chas. H. Osler, F. L. Wanklyn, Thos. Kirk, J. T. Lemire, R. M. Hannaford, H. B. Stuart, J. S. Costigan, James Ewing, C. S. Leech, Fred Thomson, J. A. U. Beaudry. From Ottawa: Col. W. P. Anderson, Geo. A. Mountain, Wm. Crawford, E. J. Walsh, C. Thomson, A. Campbell, R. F. H. Bruce, C. A. Bigger, Wm. McCarthy. From Toronto, W. T. Jennings, Willis Chipman, C. H. Rust, H. F. Duck, C. J. Crowley, H. W. D. Armstrong. From Quebec, L. A. Vallee, Charles Baillairge, E. A. Hoare, Armitage Rhodes, Thos. Breen, F. X. Berlinguet, Henry O'Sullivan. From Lorette, Owen O'Sullivan. From Brantford, T. Harry Jones, C. A. Waterous. From Berlin, Herbert J. Bowman. From Halifax, C. E. W. Dodwell. From Iroquois, F. R. Wilford. G. J. Desbarats. From Kingston, Prof. W. R. Butler. From Owen Sound, Jas. C. Kennedy. From Coteau Landing, Thos. Monro, Alex. Grant. From Boston, Freeman C. Coffin. From Sault Ste. Marie, Wm. Crawford. From Black Lake, Que., J. S. Costigan. From Valleyfield, J. H. Sullivan.

On calling the meeting to order the president congratulated the society on the large attendance and on the prospects for a good convention. The secretary then read the programme of the meeting, after which the minutes of the last annual meeting were read and confirmed.

The president then nominated Messrs. Howard, Costigan, Stuart, Lovelace, Heckman and Lesage as scrutineers of the ballot for the election of officers. Messrs. Walbank, Berryman and Ewing were appointed scrutineers of the ballot for the Nominating Committee.

A large part of both forenoon and afternoon sessions was taken up by a discussion on the balloting methods of the society, and the greater security of the system from errors in the future. On motion of F. L. Wanklyn, seconded by P. W. St. George, it was decided that in future when more than one ballot is cast, the color, size and all other details of the papers and enclosing envelopes shall be alike; and on motion of J. G. G. Kerry, seconded by C. H. Rust, it was resolved that no list of the ballots cast shall be made before the closing of the ballot, and that no member other than a scrutineer shall be permitted to know who has cast a vote.

REPORT OF COUNCIL.

The following is the substance of the report of council on the work of the society during the past year: The elections in the ordinary course comprised one honorary member, eleven members, twenty-six associate members, four associates, and one hundred and eight students, in all one hundred and fifty. Four associate members have been transferred to the class of member, and thirteen students to the class of associate member. Two members, removed from the roll for non-payment of dues, have been reinstated upon payment of their arrears. The elections under the Quebec Act. Vic. 62, Chap. 32, comprised three members, and fifty associate members. One associate was admitted to the class of member, and thirteen students were admitted to the class of associate member, under the Quebec Act. Resignations have been received from two associates and five students. Three members, four associate members and fifteen students have been removed from the roll for non-payment of dues. The deaths have been: Honorary member—Sir John William Dawson, C.M.G., LL.D., F.R.S. Member— Walter Shanly. Associate—Hugh Ryan. Associate Member—Emery Lafontaine. Students—F. X. Mill and M. A. Bucke. At present the membership stands as follows:

	Non-Res.	Res.	Total.
Honorary members	6	1	7
Members	247	61	308
Associate members	198	91	289
Associates	26	14	40
Students	99	104	203
Total			847

This is an increase over last year of 14 members, 57 associate members, 61 student members, and a decrease in associates of 1, making a total net increase in membership of 131 over last year. There are pending 11 applications for admission. Fourteen ordinary meetings of the society were held during the year, and one special general meeting at which the following resolution was unanimously carried: Moved by C. H. Rust, seconded by J. R. Barlow, "That the council be and is hereby instructed to purchase the property, No. 877 Dorchester street, making use of the Building Fund, amounting to $4,500, for this purpose, and also to raise $6,500 by mortgage on the property, in order to complete the purchase price of $8,000, with an additional sum of $3,000 for repairs and improvements." It was also resolved that the entrance fees, less the examination expenses, be credited to the Building Fund.

Additional subscriptions to the Building Fund were called for by circular, and the following amounts received to date: Subscriptions prior to 1899, $4,656.73; subscriptions received during 1899 and 1900: Collected, $2,084.44; uncollected, $618; total, $3,602.44.

The obligations assumed in connection with the new home are as follows: Purchase price and expenses, $8,011.30; total amount of contracts, $7,475.50; estimated cost of fittings, etc., $755; Architect's fee, $616.25; total, $16,858.05.

In connection with the work of the committees on legislation it was reported that an Act was brought before the Ontario Legislature in the early part of last year, but, owing to opposition, arising chiefly from a misunderstanding of the Act, it was withdrawn after the second reading to be introduced again during the current session. The by-laws under the Quebec Act were sanctioned by Order-in Council on February 24th, 1899. The Board of Examiners, composed of E. Marceau, S. Duval, T. Breen, C. H. McLeod, R. J. Durley and R. S. Lea, held its first meeting, November 7th, in accordance with the Quebec Act, and reported two candidates as having passed the examination for admission to practice.

The Library Committee reported a number of gifts of books and pamphlets from members and friends. Books were given by Angus M. Stewart, A. D. Watson, G. Barnett Smith, F. C. Coffin, A. Crumpton, Gabriel Henry, Wm. McNab and George Brush. Two volumes have been acquired by purchase, viz.,

Railway Track and Trackwork, by E. E. Russell Tratman, and Railway Engineering, by C. B. Smith. Pamphlets and reports on various subjects have been received from A. V. Ramachandra Aiyar, C. Baillairge, C. E. Goad, G. Henry, T. C. Keefer, C.M.G.; John Kennedy, R. Steckel, P. W. St. George, F. M Baker, Wm. R. Hill, H. B. Seaman, W. Murdoch; various exchanges were also effected. The books of the library have been appraised at $3,750, and the library furniture at $1,250. The new quarters will furnish more library accommodation, and enable the committee to carry out many improvements.

FINANCIAL STATEMENT.

The following is an abstract of the receipts and expenses for the year ending 31st December, 1899:

Balance from 31st December, 1898		$ 5,893 22
GENERAL RECEIPTS.		
Subscriptions—		
Arrears	$1,186 00	
Current	2,944 50	
Advance	381 65	
Entrance fees	480 00	
	$4,992 15	
Transactions sold	7 50	
Two dividends on Canada Permanent Loan Company's stock	9 00	
Refund on printing	0 25	
Refund on engraving medal	0 75	
Bank interest on current account	53 85	
Bank interest on deposit receipt	69 03	
	$ 5,141 53	
	$11,034 75	

GENERAL EXPENDITURE.

Part payment for house, No. 877 Dorchester street	$ 3,400 00
Transactions printed and published	712 80
Advance proofs	98 75
Printing, stationery and binding	376 52
Charter, by-laws and list of members	124 00
Postage and post-cards	244 64
Messengers and telegrams	18 26
Cabs, cartage, etc	8 75
Secretary's salary for year	300 00
Assistant secretary's salary for year	480 00
Caretaker's wages for year	144 00
Keeping rooms open at night and Saturday afternoons	118 00
Rent of rooms for year	700 00
Telephone service for year	30 00
Bank commissions on cheques	8 00
Water rates	26 68
Electric lighting for year	72 12
Books, magazines and library expenses	51 30
Expenses re legislation, Quebec province	263 40
Expenses re legislation, Ontario province	225 75
Expenses during annual meeting	83 15
Printing and engrossing diplomas	52 35
Gzowski medal and engraving	7 30
Office furniture and repairs	49 05
Rent of drawer in bank vault for year	5 00
Gas for grate fire	3 10
Part entrance fees transferred to Building Fund	430 00
Treasurer's expenses, car fares, etc	15 00
Petty cash in hands of assistant secretary	7 59
Examiners' fees	50 00
Ice for season	5 00
Insurance on 877 Dorchester St. till Aug. 27th, 1902	25 00
Insurance on present rooms till 18th Sept., 1902	14 40
Builder's risk on 877 Dorchester St. for three months	15 00
	$ 8,104 91
Balance on hand	2,869 84
	$11,034 75

D. MacPherson,
E. Marceau,
Auditors

H. Irwin, Treasurer.

The treasurer's statement of the Building Fund showed assets of $22,250, made up of cash in hand from general fund $2,869, from Building Fund $2,431, arrears of fees and subscriptions to Building Fund about $1,948; value of house, land and improvements, $10,000; books and furniture, $5,000. The expenditure on the house during the year was $6,812. The report was adopted.

The report of the Committee on Legislation was presented by Willis Chipman, as follows:

The Committee upon Legislation appointed at the last annual meeting of the society to promote the passage of an Act respecting civil engineers, a draft of which was laid before the society at the last annual meeting, begs to report as follows: Several meetings of the committee were held in January, February and March of 1899, and several conferences were held with the Minister of Education of Ontario and our solicitors, the result being Bill No. 136. The bill was introduced into the House as a private measure, and the fee ($100), paid. The Bill was referred to the Private Bills Committee two or three days before the House prorogued, and was referred back by the committee. The bill was opposed by Prof. Harris, of Queen's, and by Mr. Bell, secretary of the Canadian Mining Institute The Government refunded the committee the $100 deposited when the application was made for introducing the bill. The committee has held two meetings during this month, and has gone carefully over the bill of last year, making some alterations that should remove the opposition from the members of the Mining Institute and mechanics.

The president observed that the opposition in Ontario was largely due to popular ignorance of what the society's aims were. Some of the labor organizations were under the apprehension that the society was opposing their interests; but when they see that this society will prove a help and not a hindrance to the legitimate aims of all labor organizations, whether skilled or unskilled, they will no longer oppose it.

Mr. Chipman said it must not be supposed that because the committee had not accomplished much they had been idle. Legislation of this kind was slower of accomplishment in Ontario than in Quebec, and the work of last session had at least disclosed where the opposition lay. Ottawa and Kingston had both been centres of opposition; in the latter case from an ex-professor of the Military College. Whether there would be time to organize our forces for the pending session of the Ontario legislature was a question.

The committee on the Gzowski medal reported that no award had yet been made, and the matter was left with the council.

Mr. Sproule stated that the committee on titles of engineers was not ready to report and asked that the committee be continued.

The committee appointed to investigate the complaint of Henry A. Gray that his paper on the lake levels had not been printed in the transactions of the society, reported to the effect that that gentleman had made considerable use of extracts from the reports of the American Government engineers and other authorities without giving credit or using quotation marks, and that such omissions had justified the editorial committee in withholding the paper from the transactions; but the committee recognized that Mr. Gray's paper contained a great deal of valuable information on the lake levels that was not accessible to members of the society, and recommended that, if he would indicate the extracts by quotation marks and give credit to the authorities to whom he was indebted, the paper be printed in the transactions. The report was accepted and the council was instructed to communicate with Mr. Gray.

After adjournment at noon Mr. Kerry reported on behalf of the committee on "Fees" appointed to investigate the question as to whether city members obtained more than their fair share of the benefits of the society. The committee, composed of Messrs. Irwin, Howard, McLeod and Kerry went over the treasurer's statements for the past five years and selected from them all expenditures which are at all of a local character. These are: Rent, janitor, night librarian, water, gas, telephone, electric light and meetings. It is not easy to say what portions of these expenditures would have to be made by the society for the conduct of its general business if it had no local membership, but in such case the expenses of a head office

and library would probably be at least $500. Deducting this sum from the totals of the items above noted the following are the local expenditures, and the income from the extra fees paid by resident members and associate members for the years under consideration:

	Fees Received.	Expenditure.
1895	$162	$256
1896	166	267
1897	176	292
1898	276	552
1899	304	599

The increase in expenditure in the last two years was due to renting an extra room and to the opening of the rooms at night. It would appear from these figures that the local fees do not fully meet the local expenditure as figured out on the above basis, but that basis is itself only an estimate, and on the other hand no value can be placed upon the service rendered by the local membership to the society in general in conducting much of its business and keeping alive its meetings and committees, duties which in some cases have become so arduous that the society must shortly expect to place paid assistants at the disposal of the treasurer and librarian. The letters which caused the appointment of the committee seem to have been written under a fear that with the opening of the new society house, the local expenses would greatly increase, but it does not appear to your committee that any expenditure upon the furnishing and maintenance of the house which may tend to advance the dignity and standing of the society as a professional society ought to be opposed by any member, whether resident or non-resident. On the other hand your committee feel that any expenditures which are not proper to a society constituted solely for professional purposes, but belong rather to the province of an engineers' club, should not be chargeable to the general funds, and would, if permitted by the council, furnish valid ground of complaint to all members not benefiting by such expenditures. Your committee would suggest that this report be made a subject of discussion at the annual meeting, as it does not feel that the committee itself is sufficiently representative to make any recommendation based on the facts above presented.

Mr. Kerry added that local members had to pay an extra fee of $2 for the more frequent use they were supposed to have of the rooms. He said the policy of the society was to become the general engineering society of Canada, and nothing could be more injurious than to spend money in a way to bring no benefit to members outside the city. The library was a necessity, and we should have the best equipment in this respect that it was possible to get, but the general society should not be taxed for the pleasures of a club for the advantage of local members. During the discussion reference was made to a card room used by local members. The president and Mr. Peterson expressed surprise that a card room existed, and hoped that this feature of the rooms would be done away with at once, otherwise the local membership of the society would degenerate into a club.

Mr. Dodwell, speaking as an outside member, thought the society should not begrudge the cost of proper quarters. He had not been here for two years, and might not be here for another two years, but he was quite willing to pay his share of the cost of maintaining a proper home for the society.

Mr. St. George said it was the intention in the new quarters to provide sleeping accommodation for two; this was for outside members, who might prefer to lodge at the society's rooms instead of going to an expensive hotel. After further discussion the following resolution was passed on motion of Mr Sproule seconded by Mr. Kerry: That no expenditures from the society's funds shall be incurred either in purchases or maintenance, which are not necessary to the carrying on of the business of the society as a whole, and in the direct interests of the general membership, and that this resolution be transmitted to the council as the expression of the annual meeting.

The president made a feeling reference to the deaths of Sir William Dawson and Walter Shanly as old and highly honored members of the society, and it was decided to send formal resolutions of condolence with the families of the deceased, and of other members who had passed away during the year.

The secretary read the results of the circular post-cards, which had been sent out soliciting the opinion of members as to future conventions. The following was the list of questions, and the total number of answers for and against:

1. Are you in favor of continuing the present arrangement of holding the annual meeting in Montreal in January of each year?—Yes, 95; no, 103.

2. Shall the society hold a summer convention at different places each year?—Yes, 177; no, 19.

3. If in favor of summer convention, in what month should it be held? Of the total answers 28 were in favor of June, 25 of July, 36 of August and 32 of September.

4. If such convention is held should the annual meeting be at the same time and place?—Yes, 119; no, 70.

It was moved by W. J. Sproule and seconded simultaneously by L. S. Pariseau, Duncan MacPherson and T. Harry Jones, that $200 of the society's funds be devoted to the National Patriotic Fund. This was carried by a standing vote, the members singing "God Save the Queen."

The scrutineers for the nominating committee reported that the following had been chosen for this work:

Quebec—L. G. Papineau and C. de B. Leprohon.

Ontario—C. H. Rust, J. Galbraith and Geo. A. Mountain.

Manitoba and N.W.T.—Col. H. N. Ruttan.

Maritime Provinces—Dr. Martin Murphy.

Newfoundland and Foreign—Lewis Skaife. Messrs. W. T. Jennings, W. G. McN. Thompson and T. C. Keefer, the three last presidents, are ex-officio members of the committee.

President Jennings then delivered his annual address as follows:

On retiring from office I take this opportunity of again thanking the society for the high honor conferred in electing me to the presidential chair, and to express regret at my inability to have given the duties of the office the full attention they demanded. However, if not frequently in attendance, I have had the society and its objects fully in mind, and my constant desire has been to see the society attain a position where from its standing and activity in the advancement of scientific education, coupled with wise regulations and a high standard of ethics, it will command the hearty support of engineers in all branches of the profession, and also the respect of the public at large.

Referring to our inception, formation and advancement, I may briefly remind you that the society was established by a Dominion Government charter early in 1887 "for the object and purpose of facilitating the acquirement and interchange of professional knowledge among its members, and more particularly to promote the acquisition of that species of knowledge which has special reference to the profession of civil engineering, and, further, to encourage investigation in connection with all branches and departments of knowledge connected with the profession." The society was also empowered "to acquire and hold all land and property necessary and requisite in order to carry out the objects and purpose for which incorporation was sought." The numerical strength of the society during the first year (1887), was as follows: 188 members, 45 associate members, 10 associates, 83 students; in all 335 members. During the same year the sum of $2,480.77 was paid in to the treasurer, principally on account of annual subscriptions.

From the secretary's returns it appears that the membership for 1899 numbered as follows: 7 honorary members, 308 members, 289 associate members, 40 associates, 203 students; in all a total of 847 members, and showing a total net increase since the year of the formation of the society of 512 members of all grades, while the receipts from entrance and annual fees, etc., amounted to $5,141.53. This sum, added to the amount of $5,893.22, brought forward from general fund account, makes a total credit balance at the end of 1899 of $11,034.75, which sum has, as you will notice in the treasurer's statement, been largely drawn upon for building account.

Permanent withdrawals from membership have been few, and due in most instances to removal from the country. Removals by death have cost us many worthy members, among whom we sincerely regret, Sir John William Dawson, C.M.G., LL.D., and two past presidents, namely, Mr. Samuel Keefer and Sir Casimir Gzowski. Mr. Walter Shanly may also be included in the number of past-presidents, as he was on several

occasions offered the nomination, but invariably declined. As is well-known, these gentlemen were of the highest professional and social standing, and heartily entered into the scheme for the formation of the society, and did their part nobly to advance all its interests from the date of its formation up to the time of their decease. Others have departed who, although perhaps not as prominent before the public and in our midst, acquitted themselves honorably in the profession and faithfully as members.

The society, having carried out the second provision in its charter, is now to be congratulated on the acquisition of its own premises (as referred to in the treasurer's report), at a total estimated cost for improvements, etc., $8,846.75; building and land, $8,011.30; total, $16,858.05. Of this amount there has been obtained by special subscriptions from members and friends the sum of $8,259.17. The balance of $8,598.88 has been temporarily provided for by loan from the general funds of the society.

It is confidently hoped that monetary aid sufficient to extinguish the whole building account item of $16,858.05 will be secured, thereby enabling the society to apply moneys now temporarily loaned from the general funds to other useful purposes, notably the enlargement of the reference library, which is now valued at $3,750, or, with furniture and fittings at a total of, say, $5,000, all of which can be inexpensively removed to our own premises, which it is hoped will be ready for occupation by the 1st of May next. The benefit to be derived from having one's own professional home will doubtless strike every member as the beau ideal of seclusion and comfort. We now know that we have a headquarters, where we can meet and discuss topics of professional interest, or where we may individually rest by times when here. It has been stated by some of our members that the establishment has involved too great an expenditure, and that only local members would profit by it. I would remind these gentlemen, that, as before stated, a large proportion of the cost was subscribed by members and friends for this particular purpose, which the society has had in contemplation from the outset.

I am satisfied we will do more individually and collectively in this way in the near future, and that we will doubtless soon have the pleasing duty of determining whether our surplus funds are to be devoted to the wider distribution of engineering information beyond that emanating from papers by our own members, or expend it in additions to our reference library, or, finally, stop the accumulation of funds by decreasing the annual subscription fee. I cannot think that the latter course would meet with the general sanction of the members, because, as time wears on, coupled with the general growth of the country, an ever-increasing demand will make it imperative that our members be promptly informed of the latest engineering advances. However, as we have not yet reached that stage, it is unnecessary to further enlarge on the subject, and I only mention the matter as food for thought and discussion later on.

As to the second part of the assertion, that only local members would really profit by the establishment of our home, I may say that such must necessarily be to some extent the case, and we who are not at headquarters can only hope that those who are so fortunately situated will take full advantage of the opportunities afforded. Members should look on this feature in a broad light, and recognize that, while distant from the home, yet the advantages of it are apparent, in that the library is open to us should we at any time desire information as recorded in our reference volumes, by simply making application to the secretary for the loan of the required work, which, if too voluminous to transmit, and the subject matter required not too extensive, there is no reason why arrangements should not be made for its transcription and transmission to the applicant. In this and many other ways can the "home" be made a bond of usefulness to the members of the society, while its firm establishment means that the Canadian Society of Engineers has become a permanent and fully recognized institution of the country.

The advancement of economic mining has had the effect of attracting experienced mining engineers to the country, and of inducing a large number of students to take up that branch of the profession, with the result that a separate society, called the Canadian Mining Institute, has been successfully formed, and, as it is desirable that all branches of engineering should be embraced in the Canadian Society of Engineers, it is hoped that this valuable branch will be united with us in the near future.

Acknowledgment as a corporate body has been obtained from the Legislatures of the provinces of Quebec and Manitoba. An effort has been made in the same direction in the province of Ontario, but so far without success. It is, however, hoped that substantial advancement will be made in this respect during the coming session of the Ontario Legislature, and it is not difficult to see that the carrying out of the provisions in our bill will not only benefit the profession and the operative, but also assist all intelligent and well-disposed persons by the elevation of the educational standard and general proficiency of the civil engineering profession of this country. In connection with our desire for provincial incorporation, it has been stated, by those opposed to the measure, that our common object is to thoroughly entrench ourselves behind the Act in order that we may the more successfully wage war on those now practicing who have not thought fit to ally themselves with the society; also to legally enable us to exact enhanced fees for services, and generally to place a curb on free and untrammelled labor, be it professional or otherwise.

In reply to this and other like statements, I would briefly point out that the old days of casual study as a pupil principally carried out in the office, field or on works, and generally based on theoretical education of a more or less complete character, are almost past and gone, and while recognizing and upholding many good features in the old system, yet the near future will find only men in the profession who are graduates of schools of engineering or of this society.

Therefore (while not wishing to interfere with any one now engaged), the society seeks incorporation (in the provinces) particularly for the purpose of placing the foot of the student firmly on the first rung of the ladder by insisting that he shall have the foundation work of his profession securely laid in the form of a good academical education, and that his further ascent may be made under the guidance of experienced engineers, whose duty it will be to encourage him, until time and experience in actual service enable him to become a full corporate member, and competent to stand alone and unaided.

In the matter of fees for professional services, the society has not made special provision, and it is desirable that a plan be formulated whereby satisfaction and uniformity may be obtained in this respect, as is customary in other professions.

When one thinks of the duties and responsibilities vested in an executive engineer, in charge of extensive and costly works, and often acting in a judicial capacity as between Governments, companies or municipalities, as against each other or contractors, and compares the returns they receive with those obtained by our judges and leaders in mercantile pursuits, we certainly cannot be charged with placing a high estimate on ourselves.

As to interference with skilled or ordinary labor, I hold that the reverse is the case, as by the better and more systematic education of our engineers we create a competent force to guide and assist skilled artizans and mechanics, in advancing their interests, either as inventors, operators or overseers, of the laboring masses, who thereby cannot fail to obtain improved conditions.

As an index of this feature, it is only necessary to point to the valuable assistance rendered by schools of technology in Europe, and on this continent, where the ordinary mechanic may, by evening study under engineers, chemists and other suitable professors, secure for a trifling sum such knowledge of a scientific character as will enable him the more clearly and effectively to study out and improve upon present machinery and methods of manufacture, and generally bring under the control of the hand of man the powers and material of the physical world.

The ethical principles which should be observed between members are not difficult to determine, and may be summed up in the tenets of the "Golden Rule," and are largely provided for in our by-laws. It has, however, been suggested that members enjoying permanent positions, and whose compensation is in consideration of the occupation of their whole time, should discontinue outside professional practice in so far as the interests of the country or municipality will permit.

It is to be hoped that the "transactions" of the society will

be increased in volume by the addition of articles other than those emanating from members of our own society.

I have thus briefly touched upon society matters rather than those of a specifically engineering character, as has been the custom heretofore by retiring presidents, feeling that at this time, when we are entering upon a new and more extended era, it would appear advisable that our members should be reminded of the objects of the society, and of the duties and obligations of its members to the public, and to each other in order that we may the more fully understand our position.

In concluding, I can only express a hope that our efforts will continue to meet with success, and that each member will personally feel that the society is of real value, and of benefit to our country.

On motion of P. A. Peterson, seconded by Thomas Monro, the thanks of the society were tendered to the president, who, in his suggestive and instructive address had taken an entirely new line of thought in presidential addresses.

John Kennedy, who had been moved to the chair, complimented the president on the practical features of his remarks. The address would prove not only helpful to members, but to the general public, who might wish to know the aims and purposes of this society.

The election of officers for the ensuing year resulted as follows:

President—H. T. Bovey.

Vice-Presidents—G. H. Duggan, Percival W. St. George and E. H. Keating.

Secretary—C. H. McLeod.

Treasurer—H. Irwin.

Librarian—E. A. Rhys-Roberts.

The Council (the returns for which could not be presented till after the meeting), was as follows: John Kennedy, C. H. Rust, Thos. Monro, G. A. Mountain, Duncan McPherson, T. H. Tracy, St. George Boswell, James Ross, E. Marceau, H. Wallis, Prof. J. Galbraith, R. Hering, J. M. McCarthy, W. McNab and C. E. W. Dodwell.

Prof. Bovey in thanking the society for electing him to the presidency, said he had not sought the position, but was, in fact, in England when he was nominated. He therefore felt the honor to be all the greater, and would do his best to show that it was merited.

On motion of Herbert Wallace, seconded by Stuart Howard, a hearty vote of thanks was tendered to Mr. Jennings for his services as president during the past year.

The meeting for business then adjourned till Feb. 6, when the returns of the scrutineers for members of the council, as given above, were received.

After the business of the day the members to the number of sixty or seventy left by special train, placed at their disposal by the Grand Trunk, for Boston. Owing to press of other matter an account of the visit is held over till next issue. One of the events of the trip was the annual dinner, a report of which follows:

THE ANNUAL DINNER.

The annual dinner of the society was held at the Hotel Brunswick, Boston, and proved an occasion to be remembered by all who attended.

The chair was occupied by the president-elect, Prof. H. T. Bovey, Dean of the Applied Science Faculty of McGill University, who had on his right C. Frank Allen, professor of railway engineering in the Massachusetts Institute of Technology and president of the Boston Society of Civil Engineers, and on his left, Desmond Fitzgerald of Brookline, late president of American Society of Civil Engineers, and engineer of the Sudbury Department of the Metropolitan Water Board.

Among the members and guests of the society present were: Leonard Metcalf, S. E. Tinkham, Henry Manley, H. Bissell, Prof. Geo. F. Swain, Howard A Carson, Frederic P Stearns, John E Cheney, E. W. Howe, Prof Gaetano Lanza, L. F. Rice, Chas. W. Sherman, Geo A. Kimball, A B. Corthell, W W. Cummings and I J. Hirt, of Boston; W. E. McClintock, of Chelsea, Mass.; Prof Ira N Hollis and Prof D L. Turner, of Cambridge, Mass.; T Howard Barnes, of Medford, Mass.; Alex H French, of Brookline; Geo. B. Francis, of Providence, R I; Prof C. H McLeod, Duncan MacPherson, Stuart Howard, John Kennedy Percival W. St George, J A. U. Beaudry, Fred. Thomson, A. E. Smaill, R. H. Balfour, H. Rutherford, T. H. White, F. L. Fellowes, Alex. Pringle, E. C. Amos, L. G. Papineau, Lewis Skaife, T. W. Lesage, J. S. Vindin, Wm. McNab, F. P. Shearwood, R. E. Hunter, Gordon Grant, F. E. Came, Joseph W. Heckman, Alex. J. Grant, Arthur Crumpton, R. S. Lea, Sidney Hosmer, of Montreal; C. H. Rust, H. W. D. Armstrong, E. B. Biggar, of Toronto; Charles Baillairge, Louis A. Vallee, Armitage Rhodes, F. X. Berlinguet, Henry O'Sullivan, of Quebec; C. Thomson, A. Campbell, Col. W. P. Anderson, Chas. A. Bigger, of Ottawa; C. E. W. Dodwell, of Halifax, N.S.; Prof. W. R. Butler, C. B. O. Symons, of Kingston; T. Harry Jones, C. A. Waterous, of Brantford; G. J. Desbarats, F. R. Wilford, Iroquois, Ont.; Herbert J. Bowman, Berlin, Ont.; Wm. Crawford, of Sault Ste. Marie, Ont.; Owen O'Sullivan, of Lorette, Que.; Chas. J. Crowley, of Chaudiere, Que., and J. H. Sullivan, of Valleyfield, Que.

Among the invited guests who were unable to be present were, Messrs. Charles M. Hays, general manager Grand Trunk Railway; F. H. McGuigan, E. H. Fitzhugh, G. B. Reeves, W. E. Davis and F. W. Morse, of the Grand Trunk Railway; T. A. McKinnon and Lucius M. Tuttle, of the Boston and Main system; W. A. Ritchie, of the Pullman Palace Car Co.; J. F. Wallace, president, and C. W. Hunt, secretary, of American Society of Civil Engineers; Wm. Jackson, city engineer of Boston, H. M. Whitney, president Dominion Coal Co.; J. E. Hardman, president, and B. T. A. Bell, secretary, of the Canadian Mining Institute, and Prof. S. H. Capper, president Quebec Association of Architects.

After full justice had been done to an excellent dinner the chairman proposed the "Queen," and in doing so expressed his regret that the last days of our beloved Queen should be distressed by the horrors of war, but there was one consolation for the sufferings of the South African war, and that was that it had manifested the solidarity of all parts of the British Empire, and it was bringing about the solution of more than one of the problems of that Empire. After the toast had been duly honored, Prof. Bovey proposed the "President of the United States." He said the imaginary line between Canada and the United States marked no division in the hearts of the people who, though they might criticize each other in a friendly way, realized there was a kinship in sentiment as well as in blood. He never came to Boston without feeling loth to go away, and without carrying in mind some happy reminiscences of his visit. He hoped the Boston society would return this visit, and so increase those good relations which should subsist between kindred societies. The "Star Spangled Banner" was then sung, followed by "He's a Jolly Good Fellow."

"The Engineering Profession" was briefly responded to by C. H. Rust, city engineer of Toronto, who after returning hearty thanks said he wished to give place to L. J. Hirt, of the N. E. Gas and Coke Co. Mr. Hirt said Boston was practically the pioneer American city in developing the electric railway, having in the course of that development changed the types of motors five times. Boston was also one of the most advanced cities in solving problems of water supply and sewage, and owing to the number of rivers the difficulty of these problems had been increased. In the case of their own gas works they had to tunnel under the river, the work being done by compressed air. The iron pipe was laid concentrically in a wooden tube, and one of the unforeseen difficulties after the tunnel was finished was the sweating of the iron pipe. In the main pipe under the river this sweating amounted to six or seven barrels of water per day. In concluding Mr. Hirt laid stress on the value of practical and technical education; and spoke in high praise of the value of Nova Scotia coal in the work carried on by the company he was connected with.

With this toast the chairman particularly associated the names of Desmond Fitzgerald, late president of the American Society of Civil Engineers; Prof. Hollis, of Harvard University, and Prof. Lanza, of the Massachusetts Institute of Technology. Mr Fitzgerald in thanking the chairman for his kind words said he felt all engineers were brothers, no matter to what part of the continent they belonged. He loved Canada, because he had often fished her rivers, climbed her grand mountains and explored her forests; but he never loved her as he did now. The Canadian Society of Civil Engineers was an honor to the pro-

fession, and he was surprised to learn that it now numbered 800 members. This fact showed the enormous development of the material resources of Canada. He spoke of the fine physique of Canadians, and remarked that when introduced to the first member he had to look up in the air to see his face. Engineering was the noblest of the professions, not even excepting law, divinity or medicine; for engineering was founded on horse sense, and this was the requisite of all. The engineer was the great unifier of the human race, for his work joined country to country, brought health to cities in pure water supplies, spanned the widest rivers and bridged the ocean itself by the steamship lines, which joined continent to continent. Mr. Fitzgerald's speech was enlivened with gleams of real Yankee humor, and was warmly received. Mr. McNab then gave a capital recitation from Dr. Drummond describing how Batisse came home from his sojourn in the States, and was followed by Prof. Hollis, of Harvard University, who said he was glad to meet the members of the Canadian Society of Civil Engineers at dinner, and to renew in this meeting the pleasant memories of his visit to Montreal under their auspices several years ago. It was to be hoped that this visit was only the beginning of many others, and that we may become neighbors indeed. Speaking to the toast he thought the words of an old friend would be very apt in this connection. This friend said, "Your profession bids fair to become the great profession of civilized nations. It provides for the homes, the material welfare, and the general well being of all people. The engineer will surely cure the tariff more effectively than the legislator, because he will by his labor saving machinery make tariffs unnecessary, and bring us to free trade." It struck the speaker that his function in modern times is far wider even than this. Mr. Fitzgerald had spoken of the railroads. Have we ever thought that the railroad system is more important in uniting the Atlantic and Pacific coasts of this continent than even a constitution framed by the people who live here? The States are bound together far more effectively by the steel rail and the telegraph wire than they could ever have been by written agreement. The Canadian Pacific is doing for Canada just what the Union Pacific has done for the United States. In contrast to the railroads in this country we have the necessity of marine transportation to Great Britain and her empire. The striking changes which have been effected by the engineer are seen in the readiness with which your country transports to South Africa an army of 200,000 men with their equipment, artillery and horses. This is almost beyond imagination—six thousand miles by sea made possible by the constructors of ships and machinery. It is no exaggeration to say, therefore, that the British Empire, or better still, its vast confederation of colonies, can be held together by means of the sub-marine cable and the steamships. It is this thought that should make us all proud of our profession and glad to belong to it. The presence in Boston at this time of the Canadian Society impressed him strongly with feelings of deepest sympathy for British people in the trials which war has brought upon them. He held by the English, as he believed that their cause is the cause of the Anglo-Saxon race, which stands as the great bulwark of civilization and individual freedom. He was sure that he spoke the thoughts of thousands of his countrymen when he expressed the deepest grief for our losses and the most heartfelt sympathy for us in this trouble. He for one followed the course of the war from day to day with the same interest and sympathy as he did two years ago that of their own war in Cuba. Time and acquaintance have brought England and America together. In Cambridge, four miles from here, he lived not far from a milestone marked "Eight miles to Boston." It was put up when this was an English colony, and the journey from Cambridge to Boston was made through Charlestown, and by ferry across the Charles River. We have many of the old colonial customs and institutions in Cambridge, and we cherish much of the old affection for English soil. No wonder then that we are drawn together at this time of trial to your people. Concluding, he hoped the two societies would soon meet again. Prof. Hollis' speech was received with much enthusiasm. Prof. Lanza on being called on said it was hard to believe Prof. Bovey was not a Yankee. He emphasized the unity of the two peoples. Referring to the toast he said the day was now past when law, divinity and medicine could monopolize the culture of the country. The great object of the professions was the best good for man, and the engineering profession stood for absolute truth, therefore, it must stand as the science of all sciences. With this great aim the engineer did not stop to consider party, and was not tied within the boundaries of a country, but aimed for truth and the good of man in general. He remembered how royally the American Society of Mechanical Engineers was welcomed in Montreal some years ago, and was glad such visits as these made the ties between the two peoples closer as time went on. After the singing of "Soldiers of the Queen," by Stuart Howard, of Montreal, F. P. Stearns, chief engineer of the Metropolitan waterworks, was called on and spoke of the work done by the State Commissions appointed by Massachusetts to deal with the water supply of cities and with the liquor traffic. The work of these commissions had been most satisfactory to the public, because the appointments had been kept out of politics, having been made by the governors, who had fortunately been able and upright men.

John Kennedy, harbor engineer, Montreal, then proposed the "Boston Society of Civil Engineers," and spoke in high praise of the hospitality of the Boston engineers, whose thoughtful attentions to the Canadian visitors had delighted them all. He was much struck by the evidences of strength and prosperity shown by the Boston society, which now numbered 500 members, many of whom took such high rank in the profession in the United States. Boston was not only a pioneer in the development of electric lighting and the electric railway, but was to the front in dry docks and other harbor works. These advances were due to the able work of engineers, and he heartily wished every success to the Boston society.

Three hearty cheers were then given for the Boston society, and Lewis Skaife followed with the song "The Absent-Minded Beggar," to which he added the following original topical verses:

When you've feasted at the Brunswick, when you've kept it up o' nights,
When you've dined and wined the Boston engineers,
When you've swung around the circle and have seen the Boston sights,
And have listened to the wisdom of the seers,
You'll be absent-minded beggars for a day or two at least,
And your wits will have a tendency to leave you,
So you'd better stay in Boston with the wise men of the East,
Who have done a lot o' little things to please you,
You stay, I'll stay—stay till we sober down,
Montreal can wait for us till some other day,
Each of us doing our country's work surveying this Boston town,
We've found the service pleasant, and we'll stay, stay, stay.

Some day they'll come to see us, these same Boston engineers,
And we'll find a way to keep them when they come,
We'll dine them at the Windsor and we'll drink the cup that cheers,
And we'll make them feel exceedingly at home.
We will build a solid highway from St Lawrence to the Bay,
We'll be brothers in behavior as in blood,
We will join in an alliance that will never pass away,
And we'll face the world together for its good.
We'll join, they'll join, allies forevermore,
A hundred million freeborn men here and over the sea,
Each of us helping the common cause (and this shall our motto be)
Liberty, fraternity, and the world as it ought to be.

Prof. C. Frank Allen replied to the toast, saying it seemed queer for himself and members of the Boston society to be playing the part of guests in their own city, and the situation seemed to show that it was more blessed to give than receive. He spoke of the intimate and pleasant relations of the men of Boston and Montreal, an intimacy that had largely been brought about by the work of engineers, starting with Stephenson, whose achievement in building the great Victoria bridge had opened up direct railway communication between Boston and Montreal. He had not thought it possible to get as much enjoyment out of the visit of the Canadians as he had got, and he hoped this would not be their last visit.

Mr. O'Sullivan, chief of surveys of Quebec, after referring to his very pleasant trips to Boston, the first having been made in 1856, gave a comic song, "The Old Irish Stew" to the tune of the "Red, White and Blue," which was sung with a rousing chorus.

Howard A. Carson, engineer of the subway, was called on and in a thoughtful speech referred to the imaginative faculty of the engineer, who must have in his mind a conception of the structure or work he sets himself to do before it exists in fact. The imagination must of course be bound by the laws of nature, or the engineer would find himself as disappointed a man as the southerner who recently conceived the

idea of setting monkeys to pick cotton. Judging from the deftness of monkeys he thought he could revolutionize cotton picking, as one man might look after 20 monkeys, who could pick ten times as fast as the human cotton picker; but when he got to work he found it took about 20 men to look after one monkey, and the problem baffled him. He predicted that the work of the engineer would obliterate tariff walls, and while we might have our local governments and institutions, we did not want to have any fellow looking into our trunks when we crossed a boundary, but we wanted our horses, our timber, our coal and other products freely exchanged between the two countries.

Prof. Swain, of the Massachusetts Institute of Technology, also spoke of the satisfaction it gave him to know that the Canadian society had chosen Boston as the objective of their excursion. The ties between Canadians and Americans were growing, and they have never been so strong as they are at the present time.

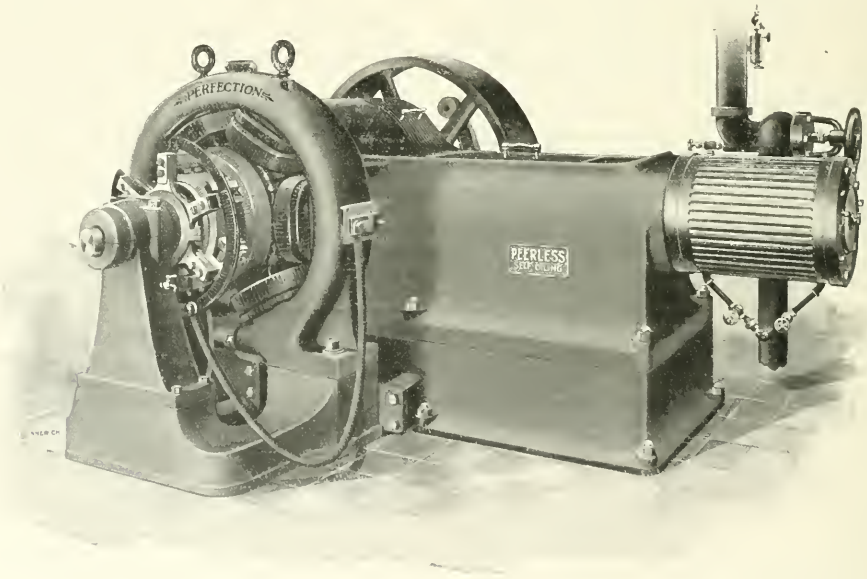
Mr. Dodwell, of Halifax, then sang "In Cellars Cool," and in response to an encore gave "Simon the Cellarer."

Prof. McLeod, of McGill University, was called on to reply to the toast of "Our Society." Briefly returning thanks he laid down for himself the law that as secretary of the society his work was to do and not to talk.

THEELECTRIC LIGHTING AND POWER PLANT OF VICTORIA HOSPITAL, LONDON, ONT.

One of the most efficient electrical equipments installed during last season was that of the Victoria Hospital at London, Ont. A rigid specification was prepared by the Gilbert Wilkes Engineering Co., of Detroit, under whose supervision the work was installed and tested. The plant, consisting of two direct connected engines and generators of 43 h.p. and 32 k.w. capacity, respectively, were to be of noiseless operation, to have a regulation within two per cent. limit, and a capability of being overloaded to twenty-five per cent. for several hours without injury. The contract was secured by the Electrical Construction Co., of London, Ltd., who have installed the entire plant, which has been in use now about five months, giving the very best of satisfaction.

Being a duplicate plant it has been customary for the engineer-in-charge to run each unit for twenty-four hours alternately with the other, as light and power are required continuously throughout the building. However, beginning with 17th February, one of the generating sets was started on a 7-day continuous run night and day, at the end of which temperatures were taken showing the following temperature rise of the different parts above the surrounding atmosphere: Commutator,



DIRECT CONNECTED ENGINE AND GENERATOR, INSTALLED AT VICTORIA HOSPITAL, LONDON, BY THE ELECTRICAL CONSTRUCTION COMPANY OF LONDON, LIMITED, AND E. LEONARD, ENGINEERS, LONDON, ONT.

Charles Baillairge, consulting engineer of Quebec city, was also called on and compared the work of the engineer with other professions, with the conclusion that engineering was the head of all professions. A general had to look at things around and facts that were visible, but an engineer had to look into and through things, and to draw inferences from things that were not visible or but dimly known. When one looked about him he would see that all the comforts of modern life were due to the skill of the engineer.

Prof. Bovey here proposed the health of Mr. Metcalf, who had personally done so much for the visitors, and the toast was drunk with "He's all right."

"The Ladies" were remembered in a humorous speech by Col. Francis, resident engineer of the N. Y., N. H. and Hartford Railway, and by T. H. White, of Montreal.

Before separating the president reminded the company of the forthcoming convention of the American Society of Civil Engineers, to be held this year in England, and he hoped not only that the attendance of Americans would be large but that many Canadians would join.

11° C.; armature core, 17° C.; crank pin journal, 17° C.; left bearing of engine, 13° C.; right bearing of engine, 11° C.; oil of engine, 16° C.; field coils of dynamo, 9° C. Considering that a limit is allowed in general engineering practice of 40° C., and sometimes 50° C., the above figures are exceptionally satisfactory. During the week the load had varied between ten per cent. overload and one fifth of full load, no adjustment of the brushes being necessary nor was any special attention required.

The engines which are supplied by E. Leonard & Son, of London, are of their new Peerless self-oiling type, and are lubricated automatically in all parts without attention. Renown engine oil being used for all bearings, and Capital Renown for the cylinder. A description of the principal features of this new engine, which is having a large sale, was given in our December number.

The equipment is electrically controlled by means of a handsome Tennessee marble switch board, provided with ten light circuit switches, five motor circuit switches, main switches, pilot lights and rheostats, etc., making a very compact and well arranged board. The plant also furnishes power for two direct

connected elevator equipments installed by Malloch & Co., of London. The electric motors and controllers of which were furnished by the Electrical Construction Co., of London, Ltd., who also installed two motors direct belted to fans, which are used to exhaust the air from the entire building. The fan motors are of the bi-polar type, and have a speed controller. The smooth running of the engines, and the steadiness of the voltage of the electric plant, have called forth high compliments from the many visitors to the new institution. The engineer and mechanical superintendent is Samuel S. Glass.

THE ENGINEERS' CLUB, TORONTO.

The annual dinner of the Engineers' Club of Toronto, took place at the Rossin House, Toronto, February 8th, and the following gentlemen were elected to the various offices for the ensuing year: President, Kivas Tully; vice-president, Prof. Jno. Galbraith; directors, C. H. Rust, representing the civil engineers; R. W. King, the mechanical engineers, and T. R. Rosebrugh, the electrical engineers; treasurer, T. B. Speight; secretary, Willis Chipman. Among the members who participated in the annual dinner at the close of the business meeting were the following: Kivas Tully, C. M. Canniff, C. E. Cooper, — Brodie, W. A. Clement, Henry F. Duck, Jno. A. Duff, Fred. G. Durnford, J. A. Ellis, W. A. Johnson, Henry A. Gray, — Gordon, Jno. Galbraith, G. H. Hanning, R. W. King, E. H. Keating, Geo. R. Mickle, J. G. Maybee, E. Phillip, Rod. J. Parke, Jno. G. Ridout, C. H. Rust, T. S. Scott, T. B. Speight, R. T. Tate, Geo. White Fraser, Jno. Williams, C. H. Wright and P. M. Wickens. The usual toasts, with music, concluded a very successful entertainment.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

PRODUCTS OF COAL.

The monthly open meeting of the Hamilton Branch of Stationary Engineers was held February 20th. The principal feature of the evening was an address by J. M. Williams of J. Winer & Co., on the subject of products that could be obtained from coal. The address was illustrated throughout by means of blackboard drawings, and specimens of the various substances named were on exhibition for the inspection of the members present. It was demonstrated that after the first product, which was heat, the next two of greatest importance were gas and coke. From the coke we obtain electric light carbons, and carbide of calcium used in the production of acetylene gas. Coal tar was the next production, and as the substances obtained from the distillation of this tar are practically innumerable, the principal products only were touched on.

We first obtain from coal tar a substance called benzol, which, combined with nitric acid, forms nitro-benzol, which is used extensively in the making of perfume. Next we procure carbolic acid, then creosote, a substance used for preserving railway ties, wharves, etc. Then follows naphthaline, used in the manufacture of camphor balls; in exceptionally cold temperatures this substance sometimes blocks up the gas pipes. We then obtain solid paraffins, principally in the form of waxes. The last product obtained through this distilling process of coal tar is pitch.

It was then shown how the articles and productions mentioned were applied to the manufacture of modern commodities of everyday use. The explosives used in modern warfare are composed largely of materials obtained from coal, such as carbolic acid, etc.; naphthaline goes into some of them, and is used in some of the cartridges of the present day. The speaker then exhibited samples of cordite and other explosives, and explained how smokeless powder differed from ordinary gunpowder. It was shown how natural articles of commerce were being imitated by productions from coal tar: such as oil of wintergreen, obtained from carbolic acid; musk, saccharine, which is 500 times sweeter than common sugar; and also artificial perfume resembling flower of lilac. In some diseases saccharine can be used where sugar could not. Gum-benzoic, naturally obtained from the sap of a tree grown in eastern countries, a substance which has been used from earliest times in making incense, and in all probability utilized in the preservation of mummies, is now artificially made in the form of benzoic acid. Mr. Williams had on exhibition a piece of gum-benzoic, which was over two hundred years old. A substance is also obtained from coal tar, which is used for much the same purposes as quinine in medicine.

At conclusion of the address a hearty vote of thanks was tendered Mr. Williams for his trouble in preparing such an interesting and exhaustive address on the subject. L. B. Mann, of Boston, a well known stationary engineer, addressed the meeting before it closed, and announced that he would be present at some meeting in the near future and address the members at some length. H. J. Wickens, of Toronto, made a few remarks, and a paper from him on electricity is looked for in the near future.

DOMINION ESTIMATES.

Railways and Canals.—The amount to be voted is $4,570,902, as against the current vote of $4,855,472. Of this the Intercolonial Railway is to receive $1,545,902, being $95,216 of a decrease. The Prince Edward Island Railway receives $713,500, as against $268,000 for the current year. Canals receive $2,311,500, as against $2,944,454 for the current year. The canal items are:

Soulanges canal, construction, $350,000; Sault Ste. Marie canal, construction, $40,000; Lachine canal, construction of lock, $500,000; Lachine canal, dredging between locks 2 and 3 and basin, $21,000; Lachine canal, building slope walls, $11,000; Lachine canal, build a quadrant pontoon gate, $20,000; Lachine canal, installation of electric light, $40,000; Lake St. Louis, forming channel, $14,000; Grenville canal enlargement, $5,000; Lake St. Francis, removing shoals, $5,000; Cornwall canal, enlargement, $60,000; Farran's Point canal, enlargement, $69,500; Galops canal, enlargement, $441,000; North Channel, forming $200,000; Galops Rapids, forming channel, $100,000; St. Lawrence River and Reaches, surveying, buoying, etc., $15,000; Trent canal, construction, $320,000; Welland canal, improvements to Port Colborne entrance, $100,000; total, $2,311,500.

In addition to the above which are chargeable to capital, there is $245,927 to be voted chargeable to income. Of this $9,000 is for Lake St. Francis; $17,000 for the Lachine canal, including $3,000 for new steel rollers for Wellington street bridge; $10,000 for St. Ours locks; $31,700 for the Carillon and Grenville canals.

Public Works, Capital.—The amount to be voted is $476,000, being an increase over the current vote of $24,000. Of this $433,000 is for the St. Lawrence ship canal, being the same as the current vote.

Public Works Income.—The amount to be voted is $1,095,423, as against $3,224,556 for the current year. The following appropriations are for Quebec:

Dominion public buildings, $12,000; Grosse Isle quarantine station, $10,000; Montreal public buildings, $5,000; Quebec Citadel, Governor-General's quarters, $2,000; Quebec custom house and examining warehouse, $2,000; Quebec immigration buildings on Louise embankment and breakwater, and Queen's wharf buildings, $5,000.

Harbors and Rivers.—Anse aux Gascons (Port Daniel East), breakwater, $1,300; Baie St. Paul (Cap aux Corbeaux), extension and repairs to wharf, $2,000; Beauport, wharf, $4,500; Berthier (en bas), repairs and open shed, $1,000; Carleton, extension of landing pier, $1,000; Grosse Isle, repairs to wharf, $1,500; general repairs and improvements to harbor, river and bridge works, $10,000; Lanoraie, repairs to wharf and construction of ice breaker, $2,500; Longueuil wharf, reconstruction and repairs, $2,500; Lower St. Lawrence, removal of rocks, $1,500; Magdalen Islands breakwater, $10,000; Matane, extension of training pier southwardly, $4,000; New Carlisle, repairs to wharf, $500; Newport breakwater, $7,000; Perce (North Cove), wharf, $10,000; Rimouski wharf repairs, $3,000; Riviere Cap de Chatte, pier, $000; Riviere a la Pipe, wharf on Lake St. John, near mouth of river, $1,000; Rive St. Maurice, channel between Grandes Piles and La Tuque, dredging, $6,300; St. Alexis, Baie des Ha! Ha! pier, $4,000; St. Alphonse (Bagotville), landing pier, repairs and shed, $500; Ste. Anne de Sorel, ice piers, $2,000; St. Fulgence, pier and improvements, $1,500; St. Jerome (Lake St. John), wharf, $2,500; St. Laurent, repairs to wharf, $700.

ARNOLD MAGNETIC CLUTCH.

In the design of the modern electric power plant it is frequently found desirable to arrange the generators in such a way that they may be readily connected or disconnected to the prime movers according to the exigencies of the service. This requirement of station design has been met by Br. Bion J. Arnold in the system known by his name. As this system requires the use of clutches, Mr. Arnold has worked out a magnetic clutch, a number of which have already been built.

These clutches are in reality friction clutches, yet the friction between the contact surfaces is not due to mechanical pressure, but to magnetic traction. The working parts of the clutches are composed of metal having a high permeability so arranged as to become magnetized upon the passage of direct current through the coils with which they are provided. The two parts of the clutch can be attracted together in this way with a pressure far in excess of that obtained in mechanical clutches, and it is only a question of making the clutches large enough, to enable them to transmit power in any desired amount. The energizing circuit is controlled by means of a switch placed at a convenient point, which is quite a decided advantage over the ordinary friction clutch. It thus becomes possible in throwing a generator in or out of service to control it entirely from the switchboard, where all the regulating devices and measuring instruments are within the reach of one attendant. These magnetic clutches also possess the advantages of neat appearance and compact design. Even in the larger sizes the amount of space occupied upon the shaft is not much more than twice the diameter of the shaft, and by using a flange forged solid on the end of the shaft, they can be made to occupy even less space when used as cut-off couplings. Owing to their having no projecting surface or parts to catch the air when in operation the windage resistance is negligible. The greatest advantage, however, of this form of clutch over others is the fact that it is self contained—the "action and reaction" being within the clutch itself, and consequently there is no resulting end thrust upon the shaft bearings and no additional friction load due to the operation of the clutch. The illustration, Fig 2, shows the largest magnetic clutch in the world. It is 100 inches in diameter, and is capable of transmitting 3,000 h.p. at 150 revolutions per minute. This clutch is one of three now in use connecting the engines and generators in the central station of the Imperial Electric Light, Heat & Power Company at St Louis, a view of the equipment of which is shown in Fig. 1. The experience with this plant demonstrates that this form of clutch is applicable to the large size units now being installed for power station purposes, whereas the ordinary friction clutch becomes especially unwieldy and unsightly after passing the 500-h.p. size.

The current is carried to the clutch coils through contact rings upon the side of the clutch, and carbon brushes held by insulated brush holders. The electrical connections are simple and easily accessible for inspection. The clutch requires no more current than would be used by four 16-c.p. incandescent lamps, and the loss in the clutch due to the continuous use of the electric current while the clutch is in operation amounts to only one-hundredth of 1 per cent. of the power transmitting capacity.

A number of these clutches have been made to connect large synchronous motors to their load in such a way that they can be quickly disconnected in case of accident, and they have also been built for use upon line shafting. They are also particularly applicable to use in connection with gas engines, as they would eliminate the flywheel problem of the gas engine in many cases, which of itself would be a distinct advantage. Indeed, there would seem to be no limit to their use wherever it is desired to transmit power from one shaft to another.

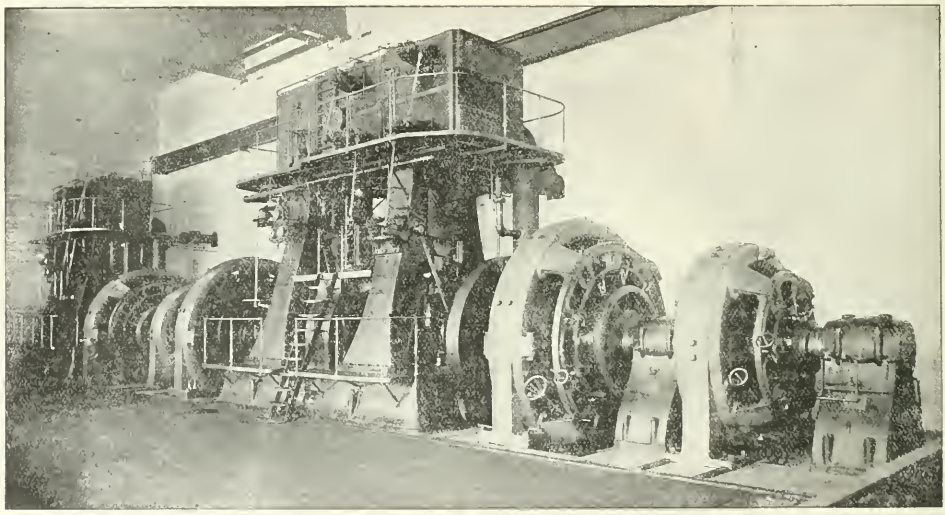


FIG. 1. THE IMPERIAL ELECTRIC LIGHT, HEAT AND POWER CO.'S PLANT, ST. LOUIS, U.S.

ELECTRIC TRAVELING CRANES

One of the subjects discussed at the Engineering Conference of the Institution of Civil Engineers in England last year was "Cranes and the Power to be Used with Them." The debate was opened by Walter Pitt, who spoke strongly in favor of electric power; indeed, he recommended it for all cranes, except those used singly, or with a great range of portability. Of course his views did not go unchallenged, seeing that he allowed but little future for the hydraulic crane, which is eminently adapted for certain classes of work. But he carried his audience with him entirely when he said that electric driving was the only one to use for overhead travelers. This is a matter which admits of no argument; the great requisite of an overhead crane is convenience in use and manipulation. There are others, but this is the chief, for a crane which can be used quickly and easily will very soon save its cost in a works. There are no travelers which fulfil this condition like those driven by electricity, particularly when the designer has had the courage to avail himself to the full of the agent which he employs. The early cranes had one motor, and the power was distributed from this to the hoisting barrel, and to the longitudinal and traversing gears by belts or other mechanisms. The arrangement was an improvement on the familiar square shaft, but still it was very faulty. It showed that the designer feared the electric motor

would give trouble, and, therefore, he thought it wise to restrict himself to a single one. No doubt he was right; motors have been immensely improved of late years, and in no respect more than by the use of the carbon brush. Without that it would have been a difficult matter to have brought the electric tramcar to the point of commercial success which it now enjoys, and other forms of motive power transmission would have failed, in a greater or less degree, to attain their present established position.

The success of the electric tramway upsets every possible objection which can be raised against the reliability of the electric motor for other purposes. On a car it runs among slush and mud, is stopped and started every two or three minutes, and has often to get into motion under loads many times the normal. It may safely be said that if an electric motor succeeds in such work—and it certainly does succeed—it may be employed with the fullest confidence in every position in an engineer's shop, for there it meets with skilled care, and the greatest demands that can be made upon it are uniformly easier than those found in a tramway. It may be a moot point how far the subdivision of electric power should be carried in the driving of tools, but its applicability and economy of power when used in traveling cranes has passed beyond the stage of discussion. The question of economy in the driving of a crane is, however, of little moment. What does matter is that no time shall be lost at the tools Lathes, planing machines, and other appliances now represent such an immense capital outlay that it is most imperative that they shall work every available minute, and this can only be done if the work can be lifted in and out with expedition and with certainty. For this work there is nothing on the market equal to the electric crane.

The most advanced practice in overhead travelers is to use a separate motor for each motion. It is not many years that Messrs. Adamson have been making cranes, their original business being that of boilermakers, and it will be interesting if we trace their connection with the new industry, as their experience reflects in a general way the history of the electric crane in this country, says Engineering, London, Eng., in a recent issue. In the early nineties the firm were in want of two additional overhead cranes, and after considerable enquiries they determined that they should be electrically driven, and that they would build them themselves, because at that time the established makers did not recommend this application of electric power. The makers of motors also cast very considerable doubt on the advisability of using reversing motors, while at the same time the cost of the motors was very high. In 1893 one of the firm went to the United States, and soon found that there did not exist the same hesitancy about using reversing motors on the other side of the Atlantic as here, and he returned with the conviction that they might proceed with confidence. On November 5, 1894, they set to work their first three motor crane, and during the next two years they constructed cranes for their own shop, proceeding tentatively and experimenting at their own cost rather than at that of their customers. In that period they built five or six cranes, not only as regards the ironwork, but also the motors and the electrical equipment. In 1897 they began working for the public, and have since turned out cranes of various sizes.

FIG. 2 ARNOLD MAGNETIC CLUTCH.

The latest crane has four motors. Their purposes are respectively to drive (1) the main barrel, (2) the light barrel, (3) the longitudinal motion, and (4) the traverse motion, and all are supplied with current at 220 volts. The main lifting speed is 4 feet per minute, the corresponding motor running at 400 revolutions per minute, and the barrel being 2 ft. 6 in. in diameter, there being three intermediate shafts between the motor and the barrel. All these spur gears are machine cut out of the solid, except the last two, which are of the double helical type, all being of steel. The first motion wheel has a bronze rim bolted on it. The use of keys is avoided wherever possible, the pinions are forged solid on their shafts, and the wheels are keyed on prolonged bosses formed on the pinions to receive them. The load is carried by a steel wire rope 5 inches in circumference, passing in two bights round two sheaves on the hook block. The two ends of the rope are fixed to the drum, and the centre bight is led round an equalizing pulley, thus

giving a true vertical lift. The light lift is intended to deal with loads up to five tons, and has a barrel 1 ft. 4 in. in diameter, around which is wound from each end, a steel rope 2¼ inches in circumference. The speed of lifting is 15 feet per minute, and the revolutions of the motor 320 per minute. The speed is reduced at two steps by one worm reduction and a pair of spur-wheels. The worm has four threads, and gears into a wheel with machine-cut teeth on a bronze rim. The worm runs in an oil bath, and its thrust is taken up in a thrust bearing of the marine type. Both lifting drums are controlled by electric brakes. These are fixed to the motor shafts, and work automatically without care on the part of the attendant. The brake wheel is pressed on by shoes applied by springs and released by an electromagnet, which is energized when the current is directed to the corresponding motor. Thus, should the current fail from any accidental cause, the brake goes on immediately, and holds the load safely. On the other hand, immediately the attendant sets the crane to lift or lower, the brake is taken off. Should the load, in falling, drive the motor too rapidly, the back electromotive force would reduce the current, and the brake would go on of itself.

The longitudinal motion of the crane is effected by the motor fixed on the end of the main girders, the speed of the motor, 300 revolutions per minute, being reduced at two stages to give a traveling speed of 80 ft. per minute. The traverse motion is derived from the motor. This runs at 500 revolutions, and gives a speed of 40 ft. per minute through two reductions. The power absorbed by the four motors is as follows when the crane is fully loaded: Main hoist, 25 brake h.p.; auxiliary hoist, 12 brake h.p.; traversing, 7 brake h.p., and traveling longitudinally, 5 brake h.p. Leaving for the moment the electrical equipment, we will turn to the dimensions and construction of the crane itself. The height of lift is 22 feet, the span is 27 ft. 4 in., and the distance apart of the girders, centre to centre, 7 ft. 6½ in.

THE ONTARIO ASSOCIATION OF LAND SURVEYORS.

The convention of the Ontario Land Surveyors was held on Feb. 28th and March 1st in the Parliament Buildings, Toronto. The attendance was large, and the interest displayed most gratifying throughout, especially in the proposal to explore New Ontario. The election of officers resulted as follows: President, Geo. Ross, Welland; vice-president, James Dickson, Fenelon Falls; secretary-treasurer, Major Villiers Sankey, Toronto; Auditors, Capt. K. Gamble, H. J. Browne. The following were nominated as councillors, election to take place by letter ballot on April 3: Capt. W. F. Van Buskirk, Stratford; Messrs. A. J. Van Nostrand, Toronto; E. T. Wilkie, Carleton Place; W. R. Aylesworth, Belleville; J. W. Tyrrell, Hamilton; H. H. Gibson, Willowdale; A. S. Code, Alvinston; John McAree, Rat Portage.

The next issue of The Canadian Engineer will contain a more detailed report of the meeting.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain, of interest to the metal trades, in January, 1899 and 1900:

	Jan. 1899.	Jan. 1900
Hardware	1,538	2,068
Pig iron	361	2,000
Bar, etc	445	1,100
Railroad		321
Hoops, sheets, etc	125	2,005
Galvanized sheets	488	5,730
Tin plates	5,685	14,738
Cast, wrought, etc., iron	997	3,201
Old (for remanufacture)		2,485
Steel	3,770	22,449
Lead	889	1,052
Tin, unwrought	2,515	3,377
Alkali	1,543	2,691
Cement	213	272

THE PROPERTIES OF NICKEL-STEEL.

Brief notices have appeared from time to time in The Comptes Rendus of the French Academy upon M. Guillaume's important researches into the physical properties of the various alloys of nickel and steel, but the complete details of these investigations have not been made public until recently. A paper by M. Guillaume in The Bulletin de la Societe d'Encouragement now describes the apparatus and methods used by him, and also gives the results of his researches more completely than they have been given heretofore. While it is impossible, in limited space available, says The Engineering Magazine in reviewing the article, to examine the work of M. Guillaume at length, the peculiar properties which he has discovered possess sufficient importance to demand a brief indication, and may render the application of the alloys important for engineering purposes in different lines from those previously considered. The principal object in view, in making these researches, was the discovery of the best alloy for metrological purposes, and the investigations covered the density, elasticity, magnetic properties, and behavior under the action of heat. They were not intended to cover the entire magnetic properties of the various alloys, but only to use these as guides to the selection of suitable proportions for further investigation. These tests showed that alloys containing from 0 to 25 per cent. of nickel are irreversible—that is, they possess two different sets of magnetic properties, according to the direction of the preceding temperature-changes, whether ascending or descending. For alloys containing 25 to 50 per cent. of nickel, on the contrary, the magnetic properties are reversible, depending at each temperature upon the temperature only, regardless of the preceding condition.

A similar condition of reversibility, or irreversibility, appeared in connection with changes of volume, the irreversible alloys showing, within certain limits, absolutely different changes when subjected to ascending and descending temperatures. The reversible alloys expanded and contracted in the same manner, whether cooled or warmed, but seemed to follow laws altogether different from those governing other metals or alloys. The peculiar behavior of the irreversible alloys can be shown only by a diagram, but the expansion and contraction of the reversible alloys is tabulated in a very interesting manner. The formula for the coefficient of expansion is given in the shape of a constant plus a function of the temperature, but neither the constant or the coefficient remains the same for different alloys. As the proportion of nickel is increased, the coefficient of expansion diminishes until the minimum is reached for the alloy containing 35.6 per cent. of nickel, after which it again increases. At this minimum proportion the expansibility is only one-tenth that of platinum, and less than one-twentieth that of brass. The great value of this alloy for standard measures of length will be seen at once, especially as it possesses other desirable qualities. The alloy is particularly homogeneous, takes a brilliant polish, remarkably free from flaws, and has a density of about eight and a modulus of elasticity of about 20,000,000 pounds per square inch.

In order to attain the best results, the bar of this alloy is subjected to a prolonged elevation of temperature, lasting for several days, after which the molecules appear to have arranged themselves in the most stable position, so that the subsequent changes of length for differences of temperature are reduced to a minimum. The influence of this reheating also renders the small, but ordinarily somewhat variable, expansion coefficient practically constant. If it is desired to secure a variation of less than 0.001 millimeter in a length of one meter, the bar should be maintained at a temperature of boiling water for 80 to 100 hours. A still greater degree of precision may be obtained by giving the bar a series of prolonged heatings for several hundred hours at successively diminishing temperatures; in this way bars for the measurement of geodetic base lines may be obtained with the temperature error practically eliminated.

A variation of 1 mikron per meter in the length of a pendulum corresponds to less than 0.05 second per day; in fact, a clock with a pendulum rod of this alloy has shown a rate of less than 0.02 second per day for a period of six months.

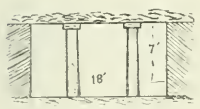
Although the researches of M. Guillaume are not yet completed, the facts which he has made public are of much value, and his full account of his work will be found both interesting and practical.

NOTES ON THE DEPOSITION AND DEVELOPMENT OF THE GLACE BAY COAL SEAMS.*

BY S. F. KIRKPATRICK, B.SC.

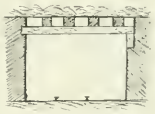
At the commencement of carboniferous times the north eastern portion of Cape Breton was overlain by a deep clear sea, favorable to the growth of coral and the deposition of limestone and gypsum. At the close of the lower carboniferous age the sea became shallower and towards the end of the formation of the millstone grit we find the rivers depositing clay, coarse sand and gravel. The succeeding age was one of extensive vegetable growth; and the rising sea-bottom became in part a swamp where the successful growth of forests deposited great depths of bituminous matter. The vegetable matter from the land probably accumulated at certain times in the shallow sea in sufficient quantities to form coal seams. When the land slowly sank fine sediment was carried down by the rivers forming shales and sandstones. These are impregnated with fossil remains of plant life and in some cases fossil animal remains.

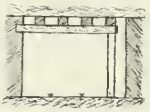
Later on the former conditions may have been reproduced by a further upheaval or shallowing of the sea. So with the action of time and pressure we have a formation composed of sandstones, shales and marls containing beds of coal. During the ages that have passed since the carboniferous times, part of the coal measures have been worn away, a large area sunk beneath the Gulf of St. Lawrence and the continuity of the beds destroyed by faulting. The strata has also been thrown into undulations, so the dip and strike of the coal seams vary very considerably at different parts of the Cape Breton coal fields. There is reason to suppose that this coal field is only the end of an immense coal area, now underlying the Gulf of St. Lawrence, extending to Newfoundland, and underlying the Magdalene Islands.

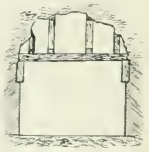


ORDINARY ROOM TIMBERING.

IN LEVEL WHEN NO PROPS CAN BE USED.


ROOF AND ONE SIDE BAD.


ROOF AND ONE SIDE BAD.


LEVEL OR DEEP AFTER FALL OF ROOF.

The Glace Bay coal beds, worked by the Dominion Coal Co., form an eliptical basin, the longitudinal axis running nearly due east and west. The greater part of this basin is under the sea; the western end only being available for mining operations. This portion is bounded on the north and east by the sea coast, and on the west and south by the anticlinals of Lingan and Cow Bay. The Lingan anticlinal is also a line of faulting, and it is as yet undetermined if there is a fault along the Cow Bay anticlinal. In this basin there are four seams of coal of considerable thickness that may be worked profitably. They are as follows:

	Approximate thickness.
Hub, coal	8½ feet.
Sandstones, shales and limestones	320 feet.
Harbor, coal	6 feet.
Sandstones, shales and limestones	400 feet.
Phelan, coal	7 feet.
Sandstones, shales and limestones	165 feet.
Emery, coal	5 feet.

The inclination of the seams vary, but it is usually under six degrees. Of the six collieries hoisting in 1908, four were working the Phelan seam, viz., Caledonia, Dominion No. 1, Old Bridgeport and Reserve.

The question of where to locate the opening of a mine and what form of opening is best generally depends on the property. A thorough knowledge of the extent of the seam, its depth, inclination and thickness are required. These facts may be obtained by examining the outcrop, and boring through the overlying strata, and further verified by slopes and drifts. Usually in mountainous country, where the strata is at a considerable inclination, it is practical to work the coal by tunnels. But in this particular case the choice lies between shafts and slopes. The latter are adapted to seams at a considerable inclination, where the outcrop is on the property, and a cheap development required. Shafts are necessary when the seam is only slightly inclined or when two or more beds are to be worked from the same bankhead. They are also best adapted to mining on a large scale, when quick returns are not so important as the ultimate cost of raising coal per ton. The question of where to sink the shaft depends, to a great extent, on the amount of capital available for development. If the shaft is sunk well to the rise the cost of hauling the coal to the pit bottom is greater, but the cost of sinking less and an early output is available. On the other hand a deep shaft would allow of a less costly system of haulage, but would take more time and money. Up to the present the greater number of the Glace Bay coal pits have compromised by sinking a shaft from 150 feet to 180 feet deep, so at first a large part of the coal could be brought to the pit bottom by gravity. This plan will no longer be followed as the Dominion Coal Co. is engaged in sinking a deep shaft to work more than one seam. Usually the shaft has three compartments, two for hoisting the mine cars and one for a man lift. The dimensions will depend to a great extent on the shape of the mine cars; which is governed by the thickness of the seam and the character of the roof. The former regulates the height of the car and the latter the breadth, because a brittle roof will allow of wider workings and consequently wider cars.

The question of the method to be employed in working the coal now arises. The chief systems are the long-wall and the pillar and stall. By the former all the coal is taken out by cutting along the wall or face of the coal, either commencing from the shaft and working out towards the boundary or by running tunnels or haulage ways to the boundary and working towards the shaft. This would be adapted to shallow seams, especially where there is a sufficient amount of splint slate, etc., in the coal to make supports, called gob-walls, for the roof. Usually, however, the roof is allowed to fall in, then if the surface property is of value there must be a sufficient depth of overlying strata to prevent the cave-in coming to the surface. By the pillar and stall method only part of the coal is removed by cutting out tunnels or rooms and leaving sufficiently large pillars of solid coal to support the overlying strata.

At the Glace Bay coal fields almost all the coal is mined in this way, for on account of the thickness of the seam and the small amount of rubbish in the coal they would have to allow the roof to cave in, when much damage would be done to the surface property. Of course it would be possible to support the roof by a system of blocks and heavy timbers, but such a method would be too costly. After sinking to the seam, levels are run out in the direction of the strike of the coal and the deeps, two or more run parallel or radiating from the pit bottom. Both deeps and levels are worked in pairs, that is two parallel tunnels usually 12 feet wide with a 12-foot wall between them. Every 66 feet they are connected by a 9-foot cross-cut, to allow the air to circulate and so ventilate the working face. A large part of the coal around the shaft is not mined but allowed to remain to prevent the settling of the ground under the bankhead and the surface buildings that are generally around the shaft. The rooms or stalls are cut off from the levels, and are worked towards the outcrop parallel to the plane of the coal.

They are about 18 feet wide with a 12-foot wall between them, and are connected every 66 feet by a 9-foot cross-cut. After working some distance down the deeps, levels are turned off as before, and rooms are commenced on this level to cut up

*From a paper read before the Applied Science Society of McGill University, Montreal.

to the higher level. In this way the entire coal area is honeycombed from the shaft out towards the boundary. When the whole area has been worked in this way, part of the remaining 40 per cent. of coal may be recovered by robbing the pillars, that is removing the whole or part of the remaining coal, working from the boundary, allowing the surface to fall in if necessary.

The timbering of a pit worked on this principle is not extensive. The overlying strata is supported by the coal pillars; but the roof of the rooms must be further supported by one or two rows of timber, say 6 inches in diameter, and placed from 4 to 8 feet apart. Occasionally the roof of the haulage ways is supported by cross timbers set in the walls or resting on one or two props. The timbers used in the main airways are usually the best 8 inch props, for there the timber is more liable to rot, due to the large quantity of air that flows past having a very deteriorating effect on them. If the coal pillars at any part of the mine begin to crush on account of the weight of the overlying strata, then very heavy timbering must be resorted to, and a larger percentage of the coal left as pillars. On the traveling roads and haulage ways the old props are frequently replaced by new ones, for the average length of a prop is only from two to four years, and on main airways often not a year. Before the work of development has advanced very far it is necessary to put in some system of haulage. The mine cars here have a capacity of from 1½ to 2 tons, and run on a narrow gauge tramway. They are filled at the working face, and are drawn by horses to the main deeps and levels. The coal mined above the pit-bottom can be let down by gravity, the full cars going down pulling up the empties. When this is not possible some form of rope haulage is employed.

The two chief methods in use in Cape Breton are the tail-rope and endless cable systems. In the former the cars are drawn in trips, that is from eight to fifteen cars hitched together. In this system there is only one track and two ropes, one for hauling the loaded cars to the pit bottom, and the other of double the length of the road passing around a wheel at the end of the level or deep to pull the empties back to the working face. The engines are usually situated underground, near the pit bottom, and turn two drums of equal diameter, so that the one will be taking in the main rope, while the other is letting out the tail-rope, and vice versa. The main rope is a much heavier cable than the tail-rope, and will be as long as the road, the tail-rope will be twice this length. In the second system there is a double track and an endless cable kept moving at the rate of about two miles per hour along one track and back the other. The cars are attached to the cable by friction grips. The full cars are drawn to the pit bottom on one track and the empties taken back on the other. The advantages of this system are: 1. Less wear on cable and on roadbed due to slower speed. 2. The tubs arrive at the pit-bottom one at a time, and the strain on the cable is more equalized on account of the cars being fairly equally spaced. 3. The cable is only double the length of the road. 4. Only one engineer is required to manage three or four endless cables.

The disadvantages are: 1. A double track is required, therefore, the deeps and levels must be wider than in the single track system, and the initial cost of roadbeds and tracks more. 2. The initial cost of the power plant will be greater. 3. Cost of maintenance of roadbed more. 4. The cable will be damaged by the grips, and accidents are often caused in the deeps by the grips slipping. When the mine car is hauled to the pit-bottom it is run on to the hoist, where it is held by an automatic clutch; it is lifted to the bankhead, and dumped, and then lowered at the same time, as the next full car is being hoisted in the adjoining compartment. The lifts are run thus in balance, the weights of the cars and cages counter balancing. The mine is usually kept dry by draining the deeps with compressed air pumps discharging into a sump or reservoir at the pit bottom, and from there it is forced to the surface by a steam pump.

In all mines of this class some form of artificial ventilation must be employed. There are at least two openings to the mine, and it is so arranged by leaving walls of coal and walling up passages, that the air entering one shaft is divided so that some of it will pass through each part of the mine before finding its way up the second shaft. During the earlier stages of development, and in certain cases of deep shafts it may be economical to force this current of air by heating the air in the upcast shaft by a fire at the foot, and so rarifying the air that it tends to rise and draw air through the mine from the other shaft. More often, however, some form of fan is used to exhaust or compress the air in one of the shafts.

GENERAL ENGINEERING COMPANY VS. THE DOMINION COTTON MILLS COMPANY AND AMERICAN STOKER COMPANY.

In a reference in our last issue to the litigation now going on between the General Engineering Company, of Toronto, and the American Stoker Company some errors occurred which we very much regret. In referring to the progress of the case it was stated that, "it was carried by the defendant companies from one court to another until it reached the Exchequer Court." The fact was that the action brought by the General Engineering Company was begun in the Exchequer Court, and all the proceedings have been in that Court. By a slip of the pen it was stated that an "injunction" had been granted instead of a "judgment" given. The substance of this judgment was given in our issue of October last, but it appears that formal judgment was not taken out, an application for a new trial having been made in the meantime by the defendants. This application first came up at Osgoode Hall on the 5th of July, and was enlarged at plaintiff's request until the 19th of September. Between these two dates the American Stoker Company applied for a writ of *scire facias* asking for the repeal of one of the Jones Stoker patents on the ground that it had expired. Judgment was given in this action in favor of the General Engineering Company on the ground that a writ of *scire facias* was not the proper remedy. The application for a new trial was then renewed by the defendants, and an order given by the Court to the following effect: That a new trial may be had on condition that the defendants pay plaintiff's costs to date, that the previous judgment be set aside, that at the new trial new evidence should be limited to the issues as to whether letters patent No. 40,700 in plaintiff's statement of claim had become void by expiry at the time of the infringements alleged, and prior to the institution of this action. It will be seen that there is no judgment now standing in the case, no damages were ever awarded, and no injunction was ever issued against the American Stoker Company. The Exchequer Court has as yet expressed no opinion, as to whether or not the patent in question is still in force, or has become void by expiry. The public are not restrained by injunction from putting in the stokers of the American Stoker Company, and the American Stoker Company is not prohibited from doing business in Canada.

NEW LAND SURVEYORS.

Commissions as Dominion Land Surveyors have been granted to C. W. MacPherson, O.L.S., Barrie, Ont.; R. Rinfret, B.A.Sc. (McGill), P.L.S., Montreal, Que.; F. J. Robinson, S.P.S., Toronto, O.L.S., Barrie, Ont.; J. N. Wallace, B.A. and B.C.E. (Dublin), O.L.S., Hamilton, Ont. The following candidates were admitted as pupils: R. H. Cautley, Ipswich, England; F. W. O. Werry, B.A. (Toronto), Ottawa, Ont.

At the recent meeting of the Board of Examiners for Ontario Land Surveyors the following candidates were admitted to practice: Wm. Walter Stull, Sudbury, Ont.; William Howard Fairchild, Simcoe, Ont.; John Henry Shaw, Pembroke, Ont., and Melville Bell Weekes, Brantford, Ont. Leonard Oswald Clarke, of London, passed the preliminary examination, and received a certificate admitting him to apprenticeship.

IT BENEFITS READERS.

Editor CANADIAN ENGINEER :

I am very much pleased with your paper, and although I have only received two numbers as yet I have derived a great deal of benefit from them. Yours sincerely,

Providence, R.I., Feb. 13th, 1900. G. V. HAMILTON.

Waring, Chapman & Farquhar, New York, have prepared plans for a system of sewerage for Ashly, a residential town now building by the Dominion Iron and Steel Co., near Sydney, C.B.

THE USE OF BOILER COMPOUNDS.*

BY ALBERT A. CARY.

To the majority of steam users, anything that is put into a boiler to lessen troubles due to the formation of scale, is a "boiler compound;" and the fact that these various so-called compounds act differently in their endeavor to accomplish their purpose is not as generally understood as it should be by those who persist in their use. Such nostrums may be divided into three classes:

First—Those attacking the scale-producing material chemically, and acting as re-agents, combine with the matter precipitated from the feed water, forming a third substance different from either the original precipitated solids or the "re-agent," the theory being that the new substance will not form into a hard, resisting scale, and therefore can be more easily removed by blowing off or by the cleaning tools used after the boiler is "opened up." Second—Those acting mechanically upon the precipitated crystals of scale-making matter soon after they are formed. Such "compounds" are of a glutinous, starchy or oily nature, and become attached to the surface of the newly formed crystals (precipitated from the water) surrounding them, as the skin does an orange; and when these crystals fall together they are thus robbed of their cement-like action, which frequently occurs when they are allowed to come in immediate contact. Third—Those acting both mechanically (as just described) and also as a solvent, the latter action partially dissolving scale already formed, and by this "rotting" effect (as it is often called), preparing the scale for easy removal.

The "compounds" under the first division (which act chemically upon the scale-forming matter) also frequently accomplish this same rotting effect upon scale formed previous to their use. Still other divisions or subdivisions might possibly be made, but the above will suffice for a good general idea of the subject. Taking up our first division of this subject, we find that the principal ingredients used in such "compounds" are soda ash (or carbonate of soda) and tannin matters, while we sometimes find caustic soda, sal soda, acetic acid and numerous other active agents which are generally less efficient in their action on the scale-forming matter and more harmful to the boiler and its fittings. In order to disguise these very cheap chemicals and help the "compound" vendor get prices for his powder or liquid, whichever, it may be, there are often added other substances which generally render the active agents less efficient, and they frequently fall unchanged to the bottom of the boiler with the scale, thus increasing the deposit and aggravating the trouble. Such added substances include clay, chalk, sand, etc., and sometimes merely coloring matter is used to disguise the original chemicals, such as tobacco juice, iron scraps, lamp black, spent tan, etc.

The principal scale-making impurities precipitated in boilers are carbonate of lime ($CaCO_3$), carbonate of magnesium ($MgCO_3$), sulphate of lime ($CaSO_4$) and sulphate of magnesium ($MgSO_4$), and, although there are generally other precipitates, notice of these alone will be sufficient for the present consideration. The chemical action taking place when some of the above named active agents are used may be traced as follows: Soda ash is a dry impure carbonate of soda, from which the pure alkali is afterwards made. The carbonate of soda (Na_2CO_3) is used to act upon the sulphate of lime and magnesia, as shown in the following chemical formulae:

	Sulphate of Lime	and	Carbonate of Soda
(a)	$CaSO_4$	+	Na_2CO_3=
		form	
	Carbonate of Lime	and	Sulphate of Soda
	$CaCO_3$	+	Na_2SO_4
	Sulphate of Magnesium	and	Carbonate of Soda
(b)	$MgSO_4$	+	Na_2CO_3=
		form	
	Carbonate of Magnesia	and	Sulphate of Soda
	$MgCO_3$	+	Na_2SO_4

Leaving this treatment for a moment, it would be well to note that both the carbonate of lime and carbonate of magnesia are held in solution through the presence of carbonic acid gas dissolved in the water, which unites with them and changes the mono-carbonates into bi-carbonates (which are only known to exist in solution), as shown thus:

Carbonate of Lime
$CaCO_3$=
composed of

Oxide of Lime	and	Carbonic Acid
CaO	+	CO_2

Carbonate of Lime	and	Carbonic Acid	and	Water
$CaOCO_2$	+	CO_2	+	H_2O=

form

Bi-Carbonate of Lime
$CaO(CO_2)_2H_2O$

Bi-Carbonate of Lime		Generally Expressed
$CaO(CO_2)_2H_2O$	=	$CaH_2(CO_3)_2$

In a similar manner the bi-carbonate of magnesium is formed from the mono-carbonate thus:

Carbonate of Magnesium
$MgCO_3$=
composed of

Oxide of Magnesium	and	Carbonic Acid
MgO	+	CO_2

Carbonate of Magnesium	and	Carbonic Acid	and	Water
$MgOCO_2$	+	CO_2	+	H_2O=

form

Bi-Carbonate of Magnesium
$MgO(CO_2)_2H_2O$

Bi-Carbonate of Magnesium		Generally Expressed
$MgO(CO_2)_2H_2$	=	$MgH_2(CO_3)_2$

The mono-carbonates (or single carbonates) of lime and magnesia are but slightly soluble in water, whereas the bi-carbonates, or double carbonates) are very soluble in cold water, and this fact will account for the presence of the large quantities of lime and magnesia in boiler waters as carbonates.

When waters containing the bi-carbonates are heated, the rise in temperature drives off the extra carbonic acid gas and leaves behind the practically insoluble mono-carbonates, which are precipitated.

When a temperature of 180 degrees Fahr. is reached, a considerable percentage of the bi-carbonates is precipitated (as insoluble mono-carbonates), and at 290 degrees Fahr. (a temperature corresponding to 43 pounds gauge pressure) the precipitation is nearly completed, after a thorough boiling.

Scale formed from the mono-carbonate of lime is seldom very troublesome, if not allowed to accumulate in too large a quantity, nor allowed to remain in the boiler for a long time; while the precipitated mono-carbonate of magnesia gives slightly more trouble, due to the fact that it seldom is found in scale as a mono-carbonate. All the contained carbonic acid (CO_2) is generally lost from the bi-carbonate of magnesia ($MgO(CO_2)_2H_2O$) by the time it forms a crust, leaving behind the hydrate of magnesia ($MgO + H_2O = MgO_2H_2$), which acts as a cement and binds closely together (though not very strongly) whatever precipitated matter it may come in contact with. This hydrate of magnesia is very fine and light when precipitated and requires a comparatively long time to settle.

(To be continued).

*Reprinted from the American Machinist

THE RED CROSS FUND

BIGGAR, SAMUEL & CO.,
PUBLISHERS CANADIAN ENGINEER.

Gentlemen,—I desire gratefully to acknowledge your handsome donation of $36, the profits on the sale of the 5th edition of your pamphlet on the Boer war. The donation is especially opportune at this time when so many of our brave fellows—Colonial and Imperial—are being wounded in their heroic efforts to uphold the cause of equal rights and true British liberty. Very sincerely yours,

J. GEORGE HODGINS,
Hon. Treas. of the British Red Cross Society, Canadian Branch.
Toronto, February 28th, 1900.

Collingwood, Ont., will vote on May 30th on a grant of $115,000 bonus to Chas. Cramp, Philadelphia, the well-known shipbuilder, to establish a smelter, capacity of 200 tons a day, in that town. There is to be an open hearth steel plant of three Wellman furnaces, and a rolling mill capable of making armor plates.

Industrial Notes.

Brantford, Ont., wants a steam road roller.

The Kingsville, Ont., glass factory will use natural gas as fuel

A large tobacco factory is being built at Kingsville by local capital.

The town of Smith's Falls paid A. Foster $35.000 for the waterworks system.

The Massey-Harris Co., Ltd., Toronto, has given $5.000 to the Patriotic Fund.

Wages of machinists employed by the C.P.R. in Toronto and Toronto Junction have been advanced.

The Reids are going to build a modern hotel, with some 200 rooms, in Fort William, St. John's, Nfld.

West & Peachey, Simcoe, Ont., have received orders recently for two of their Alligator warping tugs.

One hundred and fifty 60,000 lb. freight cars are building in Nova Scotia for the Dominion Iron & Steel Co.

The Carborundum Co., Niagara Falls, N.Y., has issued an interesting booklet, "Many Expressions, One Opinion."

The Collingwood Meat Co., Ltd., will put in at once 150 h.p. engine, and a refrigerating plant of 150 tons capacity.

Members of the board of trade, Arnprior, Ont., have subscribed $9.000 towards building a flour mill in that town.

A. J. Moxham, manager of the Dominion Iron and Steel Co., Sydney, C.B., will build a $30,000 residence at Colby, C.B.

The Walkerville, Ont., match factory is being equipped with engines and boilers by E. Leonard & Sons, London, Ont.

A well-known firm in Great Britain desires to be placed in communication with users of all kind of iron and steel tubing in Canada.

The Hamilton, Ont., Wheel and Foundry Company has advanced the wages of its moulders, the raise taking effect on February 16th.

The Keewatin Lumber & Mnfg. Co. has been closed down for a short time to build a new flume which will give a much improved power.

The Connors syndicate has awarded the contract for the elevator at Montreal to Barrett & Record, Chicago. It will cost about $1,500,000.

Essex county, Ont., has appropriated $16,000 to build a poor house. The site has not yet been chosen. Leamington offers free fuel and light.

The Manitoba Government engineer has recommended the construction of a steel bridge over the Little Saskatchewan River at Rapid City, Man.

There is reported to be a great scarcity of labor in Sault Ste. Marie, Ont., where F. H. Clergue is promoting a number of very extensive works.

The Marshall, Wells Hardware Co., Ltd., of Duluth, is incorporating a branch house, under the same name, to do business in Winnipeg, Man.

Application has been made for a charter by the Stony Plain Milling Co., Edmonton, N.W.T., to run a sawmill at Stony Plain; capital, $4,000.

The St. Charles Condensing Co., St. Charles, Ill., has established a branch in Ingersoll, Ont. The engines are Corliss, built by J. Inglis Co., Ltd., Toronto.

An association of those interested in cold storage and refrigeration is being formed in London, Eng. The secretary is S. M. Leonard, 19 Ludgate Hill, London, E.C.

The Smart Eby Machine Co., 195 Barton street east, Hamilton, is placing on the market a shaking and dumping grate bar, concerning which some strong claims are made in the advertisement in this issue.

A new type of wood pulp grinder, manufactured by McOuat & McRae, Lachute Que., is noticed in another column. This will be described in next issue; meantime those interested will get particulars on writing to the firm.

Ottawa, Ont., will spend $80,000 additional to the huge appropriation already made in its main drainage scheme. Part of the drain will be built outside the city limits.

The Fensom Elevator Works, Toronto, have the contract for the elevators for the South African Mutual Life Insurance Co.'s building at Port Elizabeth, Cape Colony.

S. B. Best has succeeded as manager of the Canadian Typograph Co., F. S. Evans, who has recently become manager of the National Cycle and Automobile Co., Toronto.

The Nickel Steel Co. is applying for powers similar to those conferred by the Railway Act upon railways, enabling it to expropriate lands, build railway lines, sidings, etc.

The Goldie & McCulloch Co., Ltd., Galt, Ont., has begun the year well. There have been sold 29 engines in the first 43 days of this year. All other departments are also very busy.

The contract for the new public buildings at New Westminster, B.C., has been awarded to Bourque & Des Rivieres, Ottawa, Ont. The amount is in the neighborhood of $60.000.

St. Louis, Que., will grant a bonus to the Phoenix Bridge and Iron Works if they build a $25,000 building, put in a $50.000 plant, employ at least 150 men, and pay $60.000 a year in wages.

There were during February 1,063 boarders at the Dominion Iron and Steel Company's dining-room, Sydney, C.B. The company have appointed nine new policemen to watch the works.

A sewage disposal plant is desired for the west end of Hamilton, Ont. E. G. Barrow, C.E., has recommended filtration as cheapest in operation. The plants already installed are chemical precipitation.

The contract for the locks, etc., at St. Andrew's Rapids, near Winnipeg, Man., has been let to T. Kelley, contractor, Winnipeg. The work will cost between one-half and one million dollars before it is completed.

C. H. Rust, city engineer, Toronto, has drawn plans for the proposed Yonge street overhead bridge. The width is 32 feet, having a 20-foot roadway and two 6-foot sidewalks. There is a double line of street railway tracks.

The Canadian Steel Co. is applying for incorporation to do a general mining, smelting, rolling mill and general construction business. Operations are to be carried on in Welland, Ont., and Hull, Que., and elsewhere.

W. M. Watson, 92 Dundas street, Toronto, whose articles on sanitary matters have interested our readers for some years past, is going to England at the end of this month to examine into the latest ideas in sewage disposal, etc.

The Canadian Canoe Co., Peterboro, Ont., has been running overtime since January 1st., and has already booked a larger number of orders than during any previous season. The No. 16 canoe is proving very popular, as in past years.

At the Montreal Rolling Mills Co.'s annual meeting the following were elected officers: A. Allan, president; E. S. Clouston, vice-president; H. M. Allan, H. Archibald, Hon. G. A. Drummond, J. S. McLennan, and W. McMaster, directors.

The chief of the fire brigade in Montreal has written the city council demanding that the high buildings in that city be compelled to put in stand pipes. This is now not the case, and such buildings are in some cases entirely beyond the reach of the fire fighting apparatus.

The R. Woodman Mnfg. and Supply Co., Boston, Mass., is famous as makers of light railroad and mill supplies. The advertisement of patent speed indicators on another page will be read with interest by all engineers and machinists. A more detailed description of these specialties will appear in our April issue.

The Austin Separator Co., Detroit, Michigan, manufacturers of the Austin Steam and Oil Separators, have just shipped an order of seven 7-inch new pattern, Fig. E., iron, horizontal receiver machines for use in the immense new power plant of the London & Bristol Tramway Co., London, Eng., in connection with Allis engines. As this is one of the most important and complete power plants installed during the past year in Great Britain, the selection of these goods is a distinct honor to American industry.

H. B. Cann, R. Caie, S. A. Crowell, A. Cann, C. W. Cann, C. C. Richards, J. H. Killam, W. Law, B. B. Law, H. Crowell, Yarmouth, N.S., and C. Burrill, Weymouth Bridge, N.S., have applied for a charter as the New Burrill-Johnson Iron Co., Ltd., to carry on the business of the Burrill Johnson Iron Co., Ltd.; capital, $50,000.

R. S. Hodgins, Sydney, C.B.; F. Macdougall, Christmas Island, C.B.; Malcolm Macfarlane, Montreal; R. B. Van Horne, Sydney, C.B., and others have been incorporated as the Cape Breton Mnfg. Co., Ltd.; capital, $10,000; to make bricks; chief place of business, Sydney, C.B..

S. R. Poulin, Ottawa, Ont.; J. Bourque, Wright & Co., Hull, Que.; A. M. Calderon, architect; J. M. Cromwell, L. O. Joly, Ottawa; C. L. Graham, M.D., Hull, Que.; W. G. Mulligan, Aylmer; J. S. Allen, Ottawa; J. Piche, Hull, Que., are to be incorporated as the Gatineau Junction Brick Co., Ltd.; capital, $20,000.

The suit brought some time ago by the Colliery Engineer Co., of Scranton, Pa., conducting the International Correspondence Schools, against the American School of Correspondence, of Boston, Mass., was recently dismissed by Judge Lacombe, of the United States Circuit Court, the plaintiffs refusing to argue the case after several postponements of the trial.

In the town of Middleton, N.S., a sewage company has been formed to provide sewage disposal for a few subscribers to the company. The capital is $1,000. There are a great many towns where partial installations could be very beneficially undertaken in this way. The rights of the municipality in its own streets being of course properly protected.

The Syracuse Smelting Works, manufacturers of babbitt metals and solder, Montreal, have announced to the trade that they have bought the supply of raw material which they expect to use this year, and advise all their friends to place their orders promptly for any raw or manufactured goods they may require, as the works expects prices to be considerably higher.

Among this year's sales of the Goldie & McCulloch Co., Ltd., Galt, are one large Wheelock engine for the Midland Elevator Co., one for Collingwood Meat Co., one for the Beaver Portland Cement Co., Marlbank, Ont.; one for the Gutta Percha and Rubber Mnfg. Co., Toronto; three for the Linde British Refrigeration Co., Montreal; one for J. Oliver & Sons, Ottawa, Ont., and several others.

The Acetylene Manufacturing Co., of London, Ont., control the rights for a number of different types of acetylene gas machines. This company has put in a 300-light plant at the Walker House, Berlin; and a 380-light plant in a town in Manitoba. Mr. Stinson, of this company, has made some interesting experiments with acetylene gas as a fuel, which will be described in our next number.

Letters of incorporation have been granted to the Artesian Ice Company of Toronto, Ltd.; capital, $1,000,000; the provisional directors are: J. R. Barber, Georgetown; S. F. McKinnon, Dr. G. S. Ryerson and J. Flett, Toronto, and J. J. Long, of Collingwood, Ont. The company proposes to equip a factory for the manufacture of ice, with a capacity of over 100 tons per day, and to provide refrigerator and cold storage accommodation.

The Imperial Paper Co., Sturgeon Falls, Ont., it is announced has sold to Lloyds, of London, Eng., the owners of The Daily Chronicle, part of its concession from the Ontario Government for three-quarters of a million dollars. The purchase of a part interest in the company by the Lloyds means that the bulk of the output of the mills will be used in The Chronicle office and that of the other newspapers controlled by Lloyds. It is known that other great English papers are negotiating for the production of their paper supply in Canada.

We are informed that the net earnings of the New England Gas and Coke Co.'s plant for December amounted to $20,000. This showing was made on an average of less than 200 coke ovens in operation during the month, with an average price of but $2.57 received for coke and with but very small sales of gas. It is estimated that net earnings for January will reach $30,000 with an average of less than 250 ovens in commission. The company is gradually increasing its coke and gas output and it is expected that by the latter part of February its entire 400 ovens will be in operation, and that it will be supplying gas to Dorchester and Charleston in addition to Jamaica Plain and Brookline.—Boston Financial News.

Harrison Watson, Canadian section Imperial Institute, London, Eng., has had the following enquiries and invites replies: 1. A northern firm of importers wishes to hear of Canadian manufacturers of gig spokes, wheels, and hickory hammer shafts. 2. A Glasgow firm points out opening for Canadian nuts and bolts, and asks for names of manufacturers; American makers are finding a market here for same. 3. An Irish firm can contract for 50,000 sets spruce box boards cut to dimensions for manufacture of patent butter boxes. 4. A Midland manufacturer of anchors and chains is prepared to appoint a resident Canadian agent. 5. A Welsh firm wants immediate quotations for 150,000 spruce and white wood boxes cut to dimensions: Tops and bottoms, 18 x 11; sides, 18 x 9; ends, 10 x 9; quotations c.i.f. London; delivery before 31st May; cash, less 2½ per cent. against B.L. and insurance policy.

Electric Flashes.

The Ottawa Electric Railway Co. made last year a net profit of $85,280.37.

The Shelburne Power Co., Ltd., is applying for a Nova Scotia charter to develop power on the Rosemay river, near Shelburn, N.S.

A firm of electrical instrument and machinery makers in the United States is negotiating for premises in Brantford, owned by Wood Bros.

W. D. Snowball and others are being incorporated as the Chatham Electric Light Co., Ltd.; capital, $50,000; chief place of business, Chatham, N.B.

Jack & Robertson, electrical supplies, Montreal, have sent us a very handsome blotting pad, which combines the useful features of a desk calendar.

The Sherbrooke Gas & Water Co. intends to install new machinery in the lighting station the coming summer, which will increase the lighting capacity by 8,000 lights.

J. C. Eyres, of Woodville, Ont., president of the Victoria Telephone Co., which controls an independent system, with headquarters at Woodville, Ont., is building its line to Lindsay, Ont.

James McElliott, a former employee of the Lachine Rapids Hydraulic and Land Co., has entered an action claiming from it $5,000 damages for injuries received by coming in contact with a live wire while working in its service.

Montreal Street Railway proposes to put its electric wires under ground. The manager in a communication to the Road Committee of the Council, stated that the company had decided to expend some $200,000 on this conduit system.

The Electrical Maintenance and Construction Co., of Toronto, has opened a branch at 143 King street east, Hamilton, with a very attractive show room, under the local management of H. J. Wickens, son of A. M. Wickens, engineer of the Ontario Parliament Buildings.

St. Catharines, Ont., is asking the Ontario Government for power to raise $150,000, wherewith to acquire water powers for the development of electrical energy, for acquiring land, for the erection of buildings, etc., all of which is intended to induce manufacturers to locate in that city.

Major Gray, Government engineer, has reported in favor of, and the Railway and Canals Department has ordered a storage battery equipment to be put in, to swing the radial railway bridge at Burlington Beach, Ont., and also to light the canal in case of accident to the radial's supply wires.

Assistant Secretary Spaulding, of the United States Treasury Department, has announced that he would not decide the question of the dutiability of electricity brought into the United States from the Dominion of Canada. He admitted that he did not feel justified in taking up the matter at this time, and it is probable that the question will never be passed upon.

The London Cold Storage Co. is putting in a lighting plant, direct connected to Leonard self-oiling engines. The Electrical Construction Co., Ltd., London, Ont., has the contract.

The London, Ont., Electric Light Co. has just put in four new boilers, and the Berlin, Ont., Gas Co., one new boiler. The Kingsville Electric Light Co. is putting in a Leonard self-oiling engine.

A company to build electric launches is being organized in Hamilton, Ont., by S. R. Sintz, Chicago, and A. Ives, Detroit. The batteries will be built by the Volta Storage Battery Co., Hamilton, Ont.

The E. B. Eddy Co., Ltd., has contracted with Conroy Bros., Deschenes, for 800 electrical horse-power at $15. The use which is to be made of this large amount of power by the E. B. Eddy Co., has not been allowed to become public.

Application will be made to enable the Buffalo Ry. Co., or the Buffalo and Niagara Falls Electric Ry. to acquire the franchise and business of the Niagara Falls Park and River Ry. Co., the Clifton Suspension Bridge Co., the Queenston Heights Suspension Bridge Co., and the Queenston Heights Bridge Co.

The Hon. A. A. Thibadeau, R. Wilson Smith, G. H. Meldrum, Montreal; T. B. Stillman and H. Hall, New York, are being incorporated as the Electric Fire-Proofing Co., of Canada, Ltd.; capital, $300,000; headquarters, Montreal; to carry on the business of treating timber, wood and other substances so as to render the same fireproof.

The Hoeffner Refining Co., Hamilton, Ont., has placed an order with the Canadian General Electric Co. for two 1,500 amp., 120 volt generators, to be used for electrolytic purposes. These machines are to be direct-connected with Stanley motors, and the power will be supplied by the Cataract Power Co. from the DeCew Falls transmission lines.

At the annual meeting of shareholders of the Hamilton Electric Light & Cataract Power Co., Ltd., the officers and directors were elected as follows: Hon. J. M. Gibson, president; Jas. Dixon, vice-president; John Moodie, treasurer; John Patterson, secretary; J. W. Sutherland, John Dickenson, M.L.A.; J. A. Kammerer, Toronto, and Allan B. Forbes and Edward P. Smith, Chicago.

At the annual meeting of the Lachine Rapids Hydraulic and Land Co., a satisfactory statement was made, and the directors re-elected. The directors' report stated that the company's revenues had been dependent on private consumers hitherto but that they hoped to secure a city lighting contract at an early date. The lighting contract is now held by the Royal Electric Co.

Mayor Wilson, of Winnipeg, Man., has prepared a by-law voting $300,000 for the purchase of the plant now operated by the gas company, or the erection of a new one; also for the securing of the franchise for private electric lighting by the city. The Mayor states that the unqualified success of the city in handling the waterworks and the street lighting proves the utility of municipal ownership, and warrants the city in securing other franchises.

The Central Passenger Association has granted a special rate of a fare and one-third, on the certificate plan, from all points in its territory to Chicago and return, for delegates and friends attending the twenty-third convention of the National Electric Light Association, to be held in Chicago, Ill., May 22nd, 23rd and 24th. It is expected that the various other passenger associations will announce the same concession at an early date.

J. Patterson, J. Moodie, J. Dixon, W. W. Osborne and the Hon. J. M. Gibson, Hamilton, Ont.; J. Dickenson, Glanford, Wentworth county, Ont., and J. A. Kammerer, Toronto, have been granted incorporation to manufacture carbolite and products from its manufacture, and to utilize slag for its production, under the name of Carbolite, Ltd. The capital of this company is $1,000,000, and the head office is to be in Hamilton, Ont.

At the annual meeting of the Canadian General Electric Company the stockholders sanctioned the issue of $300,000 in new stock. The financial statement showed remarkable increases in business during the year. The annual report showed that the net profits for 1899 were $281,905, out of which $168,000 were paid in dividends, $60,358 written off machinery and other assets, $100,000 transferred to reserve fund, and $58,437 to profit and loss account. The reserve fund is now $140,000.

The Royal Electric Co. is supplying the electrical equipment for the Pratt & Letchworth iron works in Brantford, Ont.

The town council of Neepawa, Man., in accepting the electric light power plant recently installed by the Robb Engineering Co., passed the following resolution: "That this council has much pleasure in bearing testimony to the efficient manner in which J. F. Porter has installed the engine and boilers in connection with our electric plant, and that a copy of this resolution be sent to the Robb Engineering Co." Carried.

J. S. Clark, Ayr, Ont., vice-president and managing director of the Grand Valley Railway Company, which proposes to build an electric line from Port Dover to Goderich via Brantford, Paris, Galt and Berlin, says the company has behind it some well-known capitalists in New York and London, Eng., including D. W. McNair, J. Acton Lomax, Charles R. Sickles, Dr. Sanger, of New York; Hon. Jas. Roche, late of the Alaska Boundary Commission; and O. McNair, of the Warsaw Bank, Buffalo. Mr. Clark says that he completed arrangements for buying the charter of the Preston and Berlin Electric Ry. Co. He has also bought the toll road from Ayr to Paris, Ont.

At 11 o'clock on Tuesday night, January 9th, fire occurred in the power house of the St. Jerome Light and Power Co., St. Jerome, Que., which destroyed its electric plant. On Wednesday afternoon at 3 o'clock the Royal Electric Co. was instructed by the St. Jerome Co. to forward as quickly as possible, a 75-k.w. S.K.C. generator complete with exciter and switchboard: the whole went forward that evening, was received in St. Jerome Thursday morning at 10 o'clock, the destroyed plant was removed and the new one put in its place, and the lights turned on as usual at 5 p.m. on Friday, or 48 hours after the receipt of order by the Royal Electric Co. in Montreal, lights were again burning in St. Jerome.

Marine News.

The Yarmouth Marine Railway Co. has declared a seven per cent. dividend for the year.

F. Cormier, Moncton, N.B., has invented a rudder to be carried and shipped in case of accident to the regular rudder.

Thomas Henry, Canadian freight agent of the Northern Pacific Railway, has been appointed general traffic manager of the Richelieu & Ontario Navigation Co.

The St. Lawrence Terminal & Steamship Co., Ltd., is applying for incorporation to build wharfs, docks, elevators, etc., at Sorel, Que., or some other point on the Richelieu River.

G. R. Walker, formerly on the engineering staff of the Manchester Ship Canal, is now in Canada in the interest of the proposed Georgian Bay Canal.

The Cape Island Steamship Co., Ltd., is being formed for the purpose of doing business on the south shore of Nova Scotia, with Clark's Harbor as the chief place of business; capital, $10,000.

The Davis Dry Dock Co., Kingston, Ont., has the contract to build a steam yacht for the St. Lawrence Yacht Club. It will have a draught of not exceeding two feet, will be 65 feet by 13 feet beam, and 4 feet deep. The boilers will be Davis' water tube, carrying 200 lbs., the engine 8 inch by 8 inch cylinders. The speed is to be ten miles an hour.

A large and influential deputation from Port Hope, Ont., and Cobourg, Ont., recently interviewed Hon A. G. Blair, and asked that the Trent canal plans be altered so that instead of the canal being constructed from Rice Lake to Trenton, a distance of 64 miles, it be cut from Rice Lake to Port Hope, a distance of 10 miles.

R. Pickford, W. A. Black, G. W. C. Hensley, C. S. Pickford, W. A. Black, Halifax, N.S. (of whom Robert Pickford, William Anderson Black and George William C. Hensley are to be the first or provisional directors of the said company), are being incorporated as Pickford and Black Steamships, Ltd.; capital, $600,000.

The Davis Dry Dock Co., Kingston, Ont., has closed a contract with C. Lewis, Keewatin, Ont., to build the framework of a 70 foot passenger steamboat, all ready to set up at Keewatin.

It is announced that Mr. Petersen, of the firm of Petersen, Tait & Co., the firm which secured the contract for a fast Atlantic line from the Canadian Government, contemplates establishing a through steamship service for the carriage of grain from Lake Superior to England as soon as the deepening of the St. Lawrence canals to 14 feet of clear draught is completed.

A delegation of about twenty of the most prominent owners of lake vessels on the Great Lakes went to Washington recently, accompanied by H. D. Goulder, the attorney for the Lake Carriers' Association. Their object being to induce the United States Congress to take steps toward the formation, with Canada, of an international commission which should have charge of all matters affecting the water levels of the lakes. The reasons why they are active in the matter at this time are the completion of the Chicago Drainage Canal, the construction of the "Soo" power canal, and the proposed building of a dam in Niagara.

The plans for the improvements in the Red River, about fifteen miles from Winnipeg, call for a dam across the Red River 800 feet in length, a canal 1,900 feet in length, one set of locks 215 feet in length, and dredging in the river for a distance of some 400 feet. The lock will be 215 feet long, 45 feet broad and the solid concrete will be 38 feet deep, giving the locks a high water depth of 30 feet, while at low water the depth will be 11 feet. The gates of the lock will be of steel. The approach to the locks will be by a canal from a point on the west bank of the river, a distance of 1,500 feet. The canal will be 100 feet wide, and have a depth of 11 feet. The distance to the canal from the river will be of partly wooden crib work, filled in with stone and will be 200 feet in length. The canal extends 400 feet north of the lock to the river, which will be dredged to a depth of nine feet for about 100 yards. The dam to regulate the river will extend from the east side of the locks 800 feet, to a point on the east bank of the Red River. It will be of concrete, granite faced, 32 feet at the base and 18 feet 5 inches at the top. The dam is provided with seven piers and two abutments, and also with sluice gates. The piers and abutments can be used as the base of a service bridge and from this could be worked a system of shutters and movable frames, by which the height of the dam could be increased $12\frac{1}{2}$ feet. The bridge and shutters, however, will form a separate contract.

Mining Matters.

Alex. Dick, mining engineer, of Halifax, N.S., has moved to Toronto.

A valuable copper mine has been discovered at Mill Brook, Pictou county, N.S.

The Cordova Exploration Company's gold mine in Belmont, Ont., is also producing largely.

The proposed mill to be erected at Goldenville, N.S., to handle the quartz from the Palmerston, Mayflower and other properties, it is stated will be 100 stamps.

The Atlas Arsenic Company has been incorporated to do business in Belleville, Ont., with a capital stock of $750,000. The directors reside in Ohio.

The Canadian Gold Fields Company's mill at Deloro, Ont., is said to be turning out three tons of arsenic daily. The gold product is over $300 per day.

The annual meeting of the Canadian Mining Institute is to be held in Montreal on the 7th, 8th and 9th inst. The annual dinner will be at the Windsor Hotel on Friday evening, the 9th March.

A. McElwee, L. A. May, J. R. McDonald, H. G. Catlin, New York; M. Lodge and W. B. Chandler, Moncton, N.B., are applying for incorporation as the New Brunswick Cannel Coal Co., Ltd.; capital, $1,000,000.

An estimate made shows that there are close on a hundred companies employing over 2,000 men, engaged in development and mining work in the Lake of the Woods, Seine river and Manitou districts.

J. C. Calhoun, W. S. Logan, J. E. Calhoun, C. S. Daley, New York, and H. F. Puddington, St. John, N.B., are being incorporated as the Provincial Coal Co., Ltd.; capital, $1,000,000; chief place of business, Moncton, N.B.

M. J. Galvin, Buffalo, N.Y., manager of a blast furnace at Charlotte, N.Y., making foundry pig for magnetic iron ores of good quality which could be conveniently shipped from Belleville or Trenton, Ont., has recently made a search in central Ontario.

A decision of great importance to Quebec mine owners has been given by the Quebec Government regarding the exemptions from taxation of mining property. In 1890 exemption was granted the mines for ten years, and now an extension of the exemption for another ten years has been granted.

Iron ore yielding 64 per cent. of iron, and 7 per cent. of sulphur has been found near Ten-Mile Creek, some 22 miles up the bay shore from St. John, N.B. A lease, covering five square miles, has been taken by W. E. Skillen, St. Martin's, N.B., and he proposes to do development work.

Charles Howard, in behalf of himself and other stockholders of the Vermillion Mining Company, of Ontario, is suing the Canadian Copper Company, the Anglo-American Company, Stevenson Burke, C. W. Bingham, Henry McIntosh, Chas. Baird and J. B. Wright, executors of the Cornell estate, and all stockholders of the Canadian Copper Company, for $1,350,000 damages.

At the annual general meeting of the shareholders of the Cumberland Railway & Coal Company the annual reports of the company were presented by the secretary, H. R. Drummond, which were found highly satisfactory to the shareholders. The election of officers for the ensuing year resulted as follows: President, R. Cowans; vice-president, the Hon. G. A. Drummond; general manager, R. J. Cowans; secretary, H. R. Drummond.

Toronto and Nova Scotia capital has taken up the stock, $750,000, of the Port Hood Coal Company, and bonds to the amount of $750,000 have also, it is said, been issued. The company has the assurance of their engineers that the coal, amounting to 160,000,000 tons, is as good as the Sydney coal for steam. Work will begin in the early spring, and shipping will be made from Port Hood, 100 miles nearer the St. Lawrence ports than Sydney.

K. Ludloff, a German geologist, who, since last summer, has been living in Cariboo, B.C., in the interests of Russians who wish to replant the fir forest in Litonia, from British Columbia cones, has made a discovery of great importance. Herr Ludloff is in the camp on Woodpecker Island, in the Fraser River, a considerable distance above Quesnelle, where he has been collecting seeds. While doing so he is said to have discovered extensive deposits of gold-bearing conglomerate, intersected by veins of quartz, bearing gold and iron pyrites, similar to the gold in the Transvaal. He has also found deposits of red hematite, bearing free gold. This find is in the upper Fraser valley, about twenty or thirty miles south of Fort George. The formation is Archaean.

The Bureau of Mines has commissioned Prof. Courtney de Kalb, of the Kingston School of Mines, to prepare an exhaustive report on the salt industry in Ontario. The report gives a detailed account of the extent of the salt beds, present output, purity of brine and the various grades of commercial salt put on the market, methods of working and refining, with suggested measures for the further extension of the uses of the raw material in the manufacture of soda, soda ash and salts, soaps, etc., for home consumption. A detailed report on the peat industry in Ontario will be issued shortly by the Bureau of Mines, giving an account of the extent of the numerous available peat beds, analyses of raw and manufactured peat as made into briquettes by the Dickson compression patent, with the probable value of peat as a fuel for domestic and commercial purposes. This report will be of great interest to people in the coal and wood trade.

Railway Matters.

The Canada Atlantic Railway proposes to build a 5,000,000 bushel elevator at Sorel, Que., and is asking Government aid.

Owing to the large increase in business the C.P.R. has decided to erect new freight sheds in Toronto, at a cost of about $25,000.

The C.P.R. is said to be about to tunnel under the Nepean Point Park, Ottawa, to get a western entrance into the Central depot.

It is reported that the contract for 11½ miles of the Southern Railway, has been awarded to John W. McManus, of Memramcook, N.B.

Application is being made for an Act to authorize the Kingston and Pembroke Ry. Co., to extend its line from Renfrew, Ont., across the Ottawa river to Bryson, Que.

Incorporation is asked for a company to build a railway from Batchewana Bay on Lake Superior to the C.P.R., and to James Bay at or near the mouth of the Albany river.

Ce LeB. Miles, C.E., is making a survey for a line of railway from Bristol to Foreston, N.B., a distance of some fifteen miles. The road is intended to give the lumbermen in the vicinity of Foreston a means of transport for their lumber.

Application is being made by the Montfort and Gatineau Colonization Ry. Co., for leave to extend its line from the Great Northern Ry., near St. Canut, Que., to the Union Jacques Cartier Ry., near Montreal, passing through the counties of Two Mountains, Laval and Jacques Cartier, and connecting with the Union Jacques Cartier Ry.

It is said that a syndicate will make an offer for the purchase of the Kingston locomotive works, now in liquidation, and that among those concerned in the purchase are Mackenzie & Mann, of Toronto; James Hammond, of Fort William, and others. It is said that the Ontario & Rainy River Ry. would require the manufactures of the works for the next ten years.

An unexpected turn has been given to the discussion on Erie canal enlargement by the offer said to have been made by S. R. Callaway, president of the New York Central Railway Company. He has offered, it is stated, to transport free to shippers all the grain they may send across the State of New York for export if the State will pay its road four per cent. on the $60,000,000 proposed to be expended on the enlargement of the Erie canal. The interest on that sum would amount to $2,400,000 per annum.

John M. Nicol is the projector of the Quebec & Lake Huron Ry., the proposed air line between Georgian Bay and Atlantic tidewater. He said in a newspaper interview: "The line will be about 461 miles in a straight line through a new and unsettled portion of Canada, and would shorten the grain haul from Chicago and Duluth to the seaboard by fully 500 miles. The rail route would be about the same length as that from Buffalo to New York, saving all the lake distance between Georgian Bay and Buffalo. From Quebec to Liverpool is called 2,660 miles; from New York to Liverpool, 3,130 miles, giving us another 470 miles saved on the ocean, or nearly 1,000 miles less distance over our road to Liverpool from either Duluth or Chicago than over the present routes."

Very satisfactory progress is being made on the Inverness and Richmond Ry., which Mackenzie & Mann are building from Port Hastings to their mines at Broad Cove on the west coast of Cape Breton. The company owns extensive coal areas there, and the railroad is to carry the coal to Port Hastings on the Strait of Canso, which is to be the shipping point. Construction was started at the Strait in July last, and by December 1st the rails were laid over the first thirty miles. It is expected trains will be running over the whole line by December next. W. Z. Earle is chief engineer, and Ryan & Macdonell, of Montreal, are the contractors for the whole work, having as their manager Hugh Dokeny. The sub-contractors are, M. J. O'Brien, Renfrew, Ont., and Pegnem & Doheny, of Montreal.

LITERARY NOTES.

The Canadian Almanac for 1900 is issued as usual by Copp, Clark & Co., Ltd., Toronto. The historical diary contains more than usual, and a list of titled Canadians is given.

The Canadian General Electric Co., Ltd., has sent its friends a large wall calendar, which shows a number of views of the company's handsome new offices on King street, Toronto.

A graduates' magazine, "The Technology Review," has just been issued by the recently organized association of Class Secretaries of Mass. Inst. Tech. It is an octave volume of 140 pages, and of the best workmanship. The cover, designed by Hapgood, and printed on Army brown paper, is very handsome. The first number contains the announcement; a photograph with biographical sketch of President Crafts; articles on the Function of the Laboratory, by Prof. S. W. Holman, and on the Pierce Building, by Prof. E. B. Homer, the architect; reprints in fac-simile of early institute documents and letters—all in the first and more general half. The latter half, seventy pages, is given to news of the institute, of the undergraduate and graduate classes.

THE TORONTO TECHNICAL SCHOOL.

At the inaugural meeting of the Toronto Technical School Board, C. March was elected chairman for the year, and Ald. Hubbard vice-chairman. The committees were elected as follows:

School Management—D. J. O'Donoghue (chairman), L. J. Malone, R. Y. Ellis, A. F. Wickson, Ald. Urquhart.

Property—John Tweed (chairman), Ald. Hubbard, W. A. Langton, William Henderson and Thomas Cannon, jr.

Printing and Supply—Robert Glocking (chairman), James Wilson, Ald. Ward, William Rowe and A. M. Wickens.

Finance—C. Moseley (chairman), Mayor Macdonald, J. D. Allen, Ald. Leslie and F. B. Hayes. The treasurer's report for the year showed expenditures $12,294 and receipts $11,391.

CANADIAN PATENTS.

The following patents which are of interest to the engineering and mechanical trades have been recently granted in Canada. Full details of each device, together with the explanatory drawings, are published in the Canadian Patent Office Record, which are on file in our Toronto office, and may be examined by any of our readers who wish to call for that purpose.

No. 63,756—F. H. Pitkin and J. Thompson, Chicago, Ill.; a machine for making expanded metal, having a number of cutters arranged in converging series.

No. 63,757—The Ingersoll-Sergeant Drill Co., New York; a coal-cutting machine.

No. 63,762—C. de L. Rice, Hartford, Conn.; gear cutting machine.

No. 63,763—R. V. Sill, New York; an electrical heater.

No. 63,764—D. Crane, Ruthland, Vt.; a guard rail chair.

No. 63,769—W. H. Tobey, Tupperville, Ont.; water feed regulator for boilers, by means of a float.

No. 63,778—R. Lohnston, River Falls, Wis.; hoisting apparatus.

No. 63,793—C. F. Bancroft and P. F. Sullivan, Lowell, Mass.; systems of preventing collisions on electric railways in which a feed wire on a trolley line, provided with turnouts, has in each branch an insulated section, so that when a car passes one turnout the power is cut off from an approaching car.

SITUATION—A bright young man with a thorough education, technical in mechanics, desirable, can hear of an opportunity to his advantage by addressing "Farm Machinery," Sarnia, Ont. Want a young man of good habits and address, willing to grow up with a good business. Would be better equipped if familiar with farm and threshing machinery. No money required, but must be able to give best of references.

W. M. WATSON,

92 Dundas street, Toronto, whose articles upon sanitary topics in THE CANADIAN ENGINEER have attracted so much attention, leaves for Great Britain at the end of March. While in England Mr. Watson will make an exhaustive examination of the latest improvements in sewage disposal methods, waste water purification, etc. Mr. Watson will also be glad to undertake business commissions in line with his expert knowledge.

The Canadian Engineer

VOL. VII.—No. 12. TORONTO AND MONTREAL, APRIL, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR, R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE.

Toronto Telephone, 1392. Montreal Telephone, 2589.

PHILADELPHIA AGENT: H. E. BURNETTE, 2036 N. 13th Street.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE		PAGE
Acetylene for Cooking	323	Hanger, Brantford Adjustable Drop with Patent Roller Bearings	323
Bearings, Roller and Ball	320	Industrial Notes	331
Boiler Compounds, The Use of	317	Motors direct connected to Machine Tools, New Speed	321
Canadian Society of Civil Engineers	323	Mining News	336
Canadian Asbestos Co	323	Marine News	335
Canadian Mining Institute	325	Personal	335
Calcium Carbide at Chicoutimi	330	Railway Matters	333
Electric Flashes	319	Sewage Disposal Works, Brockton, Mass.	314
Engine, The M'Ewen Automatic	330	South Africa, Its People and Trade	314
Engineering and Maintenance of Way Association	330	Speed Indicators	321
Gas Works, The Boston	313		
Grinder, A new Pulp	330		

THE BOSTON GAS WORKS.

BY CHAS. BAILLAIRGE, C.E., QUEBEC.

It may be interesting to the general public to say that during the late visit of the Canadian engineers to Boston on invitation of the engineers of that city, we visited the gas works of the New England Gas and Coke Co., which are so far ahead of anything else of the kind in any other city, both as to extent and novelty of arrangement, as to be well worthy of special mention.

I shall merely deal here with the economic features of the labor-saving appliances introduced to reduce the cost of production to 30 cents the 1,000 cubic ft. The coal used is of course of the bituminous or gas-producing kind. It is brought from Cape Breton, and costs the company but $2.63, delivered alongside the wharf at Boston. It consists solely of what is called slack or screenings of every degree of fineness up to and not exceeding an inch or less in size. A clam shell dipper from an elevated staging dips down into the hold of the vessel, scoops up a chaldron or more of the material, raises it to a height whence it is delivered from the clam shell into a trolley car. This car ascends along an inclined trolley way to a further height, which brings the coal immediately over the nest of retorts or furnaces into which it is to be delivered for caking or baking.

The retorts or furnaces are in nests of 50, and there are eight such nests or 400 ovens in all with a travelling feeder to each gang or batch of furnaces. Some idea may be had of the comparative size and capacity of the plant when it is known that while ordinary gas plants, like ours in Quebec or other Canadian and American cities, as well as those to be found elsewhere about the world, are but a few feet in length (6 to 10 feet), a couple of feet in width and as many in height, holding as they do a few barrow loads of coal; the Boston retorts are 30 feet long, 8 to 10 feet high, and 3 feet wide. Each of the eight nests is therefore, including the separating walls between them, some 200 feet in length, and on each side of this hive of furnaces runs an elevated rail along which the traveler passes, stopping on its way opposite the retort to be loaded. Its gates, three in number, form as many bin-like pockets in the wrought iron feeder, and after the corresponding hatchways to the oven have been removed, are simultaneously opened, delivering the coal or slack, as grain from an elevator, into the retort which has just been emptied of the residual coke of a previous charge and is ready again and red hot to receive the next supply; and when that has been baked for 28 hours and all the gas expelled, repeat the process day and night without cessation the year round.

These nests of retorts are mounted high or as if on stilts to allow of tunnels running longitudinally beneath them with parallel lines of piping, two to three feet in diameter with corresponding conduits above the retorts, the latter to receive the two kinds or qualities of gas manufactured; the so-called poor brand for culinary and heating purposes to be sold at 50 to 60 cents the thousand feet, and the richer sort for illuminating purposes at say a dollar or less the thousand feet.

Both of these gases have to be purified or cleared of their tar, sulphate of ammonia and other impurities, for which purpose they pass through the lower of the tubes thus mentioned on their way to large-sized buildings, where the gases are received in scores of large and tall iron cylinders and cooled in contact with cold water jets and coils which cause the residuals to condense, distil and run away into receptacles for the purpose, the one vessel or several of them delivering always into another or others at a lower level, and so carrying out the principle of labor-saving manipulation, by raising the coals on their delivery from the vessel to such a height that all other operations may be automatic and performed by gravity alone except where electric or steam power is made to intervene to lift the slack to its destination and work the travelers where the motion is horizontal. I have already said that the furnaces are raised above ground level, and they are so raised or built at a height sufficient to allow of their delivering their coke (which is what is left of the coal after the gas has been expelled therefrom by roasting or heating in air-tight receptacles), at a height still sufficient for final delivery into the railway cars for commercial purposes.

The operation, which is the most novel, striking,

and so to say, sensational of the whole process of gas making, is as follows: Along each side of the row or range of furnaces is a line of railway. At each end of each retort is an iron door. When, as already stated, the coal has been cooking in a red hot or incandescent state for 28 hours, more or less, according to quality, the door at the rear end of the furnace is opened; a powerful hydraulic ram moving on wheels along the rear track, just alluded to, thrusts a strong iron plate adapted to a movable axle or horizontal plunger against the rear face or end of the mass of coke to be expelled. This prism of red-hot coke, if nothing were provided at the opposite or front end to receive it, would of course fall to the ground, the front portion as pushed forward breaking off from that behind it in the same way as the protruding portion of a glacier breaks away from the parent stock and falling into the sea floats away in the shape of so many icebergs. It would then have to be removed by shovels and hand labor and thus slowly charged into the railway trucks ready to receive it. But anything like such delay would jeopardize the whole process of cheap gas production. No, there is no such slow-going process of manipulation tolerated here; everything has to be done in a minute or two, and so it is—the speeding of the coal on its way from the vessel to the works is the delay of a minute or two—the feeding of the retort is done in a minute or less, and now the emptying out of its contents has to be as speedily performed. The ram alluded to thrusts out its thirty-foot arm and pushing hand in a minute of time, or not much more, and to receive the falling mass, a railway truck, platform or box car is made to run alongside, receives the red-hot mass as it disintegrates, into an iron cradle or receptacle of the full length of the car and say some 8 feet in breadth, tilted up high on the receiving side and at such a height from the ground on the opposite side as to be able, while passing alongside an empty railway truck on a siding, to dump its contents thereinto by a simple and partial motion around its rotating axle, as with a dumping cart or snow van; the red-hot coal coming from the furnace having water thrown upon it as it falls into the first car, and from the one into the other, to reduce its heat and render it bearable by the manipulators who have a hot time of it during the process.

The gas holder at these works is over 198 feet in diameter; its height is 229 feet, partly above and partly below ground, as usual, working in four lifts in the way that the first eye tube of a telescope pulls out the second, and the second the third. Its capacity is five millions of cubic feet. The works are now using daily about 1,500 tons of coal, the output being some 4,000,000 feet of rich gas, 5,000,000 feet of poor gas, 1,100 tons of coke, 75 tons of tar, and 20 tons of sulphate of ammonia.

The mains are now laid, the larger or principal ones for the conveyance and subsequent distribution of the poorer gas for heating purposes, and when turned on and used for domestic cooking and heating, ashes and the ash bin will become a thing of the past, and no more space in cellars or tenements will have to be reserved for or taken up by the usual yearly requirements of from 10 to 20 tons of coal. Nothing thereafter but the essence of the coal will be used and the gas for heating will be turned on or off as for illuminating purposes. It is a foreshadowing of my conclusion of ten or twenty years ago, that it must come to this in the end.

For THE CANADIAN ENGINEER.

BROCKTON, MASSACHUSETTS, SEWAGE DISPOSAL WORKS.

BY C. H. RUST, CITY ENGINEER, TORONTO.

On Friday, February 2nd, 1900, several members of the Canadian Society of Civil Engineers, accompanied by Mr. Barnes, city engineer of Medford, went to Brockton, Mass., to visit the sewage works. We were met at the station by Mr. Felton, city engineer, who went with us to the works. Brockton has a population of about 40,000, the average quantity of sewage per day being between 600,000 and 700,000 gallons. The sewage is pumped to a height of thirty feet, the main being three miles in length. The separate system is in use. The sewage is treated by intermittent filtration, the municipality owning about thirty acres. About fifteen acres are used at present of which seven and one-half are under-drained. The filter beds are one acre each. At present they are experimenting with stale sewage, the sewage being allowed to stand in the mains for some hours, acting somewhat as a septic tank. The result appears to be very satisfactory. The effluent, which is discharged into a cranberry marsh, through which flows a small creek, had every appearance of being more pure than the water in the creek. There is a well-equipped chemical laboratory at the filter beds. Mr. Felton explained that they were now furrowing the beds as being more satisfactory.

The annual cost of labor, including the services of a chemist, will this year be about $2,500 or $2,600. Only two laborers are employed, who live close to the beds. At present corn is grown and last year about $300 worth was sold. Fruit trees have also been planted and appear to be flourishing. At the time of the visit the weather had been very cold and ice had formed on the surface of the beds, but the working of the beds was not interrupted in the slightest degree. At Brockton, experience shows that the stale sewage is easier to filter than the fresh. The rakings from the sludge beds are now eagerly sought for by farmers in the vicinity.

SOUTH AFRICA, ITS PEOPLE AND TRADE.

CAUSES OF THE BOER WAR.

ARTICLE V.

(Continued from last issue).

When the question of sending a Canadian regiment to help Britain in South Africa was discussed lately, one of our politicians asked, "Why should we entangle ourselves in Great Britain's foreign wars, and why should we spend our money and blood in those far-away places?" In the first place, this is not a foreign war. From an Imperial standpoint it is very much a domestic war. It is not merely a matter of the ill-treatment of our fellow-subjects in the Transvaal, but whether we are to abandon our fellow-colonists in the Cape and Natal to a misrule comparable only to that of the Turks in Armenia—whether, in short, we are to lose or hold our Empire in South Africa. The Cape, be it remembered, is the halfway house to India, to our possessions in China, to Australasia, and to the smaller islands of the Eastern Hemisphere. If it had not been for the possession of the Cape and the ability of Great Britain to send reinforcements thence to India, during

the great mutiny, she would have lost her Indian Empire then. If it was vital to Britain then, the Cape is doubly so now, when Australia has become a daughter nation, and other Eastern lands have increasing claims upon her. South Africa is, in fact, the key of the Empire in the Eastern, as Canada is in the Western, Hemisphere. Moreover, knowing what the military ambitions of the Transvaal are, and what that state would certainly do the moment Britain became engaged in a foreign war, could we, as members of the British Empire, tamely watch our sister colonies of Natal, the Cape, Rhodesia, etc., overrun and reduced to the slavery which would be their lot under Boer rule? If we did our own turn would come, and the Empire would be dismembered limb by limb.

To descend to a lower plane, Canada has a strong commercial reason for seeing British ideas prevail in South Africa. Our manufacturers are now beginning to seek foreign markets, and under the rational rule of Great Britain, a large trade development awaits Canada there. South Africa is the counterpart of Canada. We consume large quantities of goods she has to sell, such as merino wool, hides, and sub-tropical products, while she imports largely of manufactured goods, such as furniture, boots and shoes, textile fabrics, stoves, hardware, machinery, and other manufactures, which we wish to sell. South Africa is essentially a non-manufacturing country, and the United States, having studied the conditions there through its consular agents, has already built up a big and rapidly-increasing trade. Not many years ago the exports of the United States to all Africa amounted to but a few thousand dollars annually. In 1898, the shipment of United States goods to British and Portuguese South Africa alone, amounted to over $16,000,000, the increase over 1897 being a growth of over $1,480,000, or at the rate of nine per cent. These exports consisted of foodstuffs, books, cotton goods, leather goods, and a long list of manufactured articles, such as agricultural implements, bicycles, hardware, sewing machines, typewriters, carriages, furniture, canned goods, lumber, etc. In almost every one of these lines, Canada is able to compete with the United States. Here and there, it is true, some Canadian manufacturer has already entered the market, but, as a rule, the Canadian exporter is still asleep to the possibilities of that land. It is time we woke up to this, for the trade connections ought to be as close as the political fraternity, and the sending of the Canadian regiment will tend to strengthen the bonds, both in a commercial and political sense. Further reference to the trade of South Africa will be found in the section of "miscellaneous facts."

As for our duty to Great Britain, as citizens of Canada, when we reflect that in the past twenty years the Mother Country has spent over $55,000,000, according to J. Castell Hopkins, on the defences of Canada, we owe it to our own self-respect to see that at least some of this is repaid. As citizens of the Empire, does it not seem a duty to defend it when any vital part of that Empire is threatened?

What will be the outcome of the war? In all probability the union of the present colonies and states in a confederation, in principle like that of Canada, but differing in details, to accord with the varying conditions. When the British and Dutch have got together, after the present conflict, they will see, by a study of their past history, that the policy of mutual hate, distrust and intolerance, is a policy that must mark their land with ruin; but the policy of good-will among the white races will make South Africa what its climate and latent resources fit it to become—one of the most delightful in the world. This much is certain, that in the settlement to be made, the British Government will not revisit upon the Boers the injustice under which the Uitlander population has groaned for the past eighteen years, but will see that there shall be absolute equality of rights among the white races, and fair, just treatment of black and white from the Cape to the confines of British Central Africa.

MISCELLANEOUS FACTS RELATING TO SOUTH AFRICA.

The following miscellaneous information, relating to South Africa, will be of interest to the reader in studying the present conditions:

Mr. Garrett, a well-informed Capetown journalist, estimates the white population as follows, distinguishing the Dutch from the British in the same table:

	Dutch.	British.	Total White Population
Cape Colony and Bechuanaland	265,200	194,800	460,000
Basutoland	300	350	650
Orange Free State	78,100	15,600	93,700
Natal and Zululand	6,500	45,500	52,000
Transvaal	80,000	123,650	203,650
Rhodesia	1,500	8,500	10,000
Total	431,600	388,400	820,000

John Noble's "Handbook of the Cape and South Africa for 1893," gave the area and white and colored population of South Africa, as follows:

	Area sq. miles.	White population.	Colored population
Cape	221,311	376,987	1,150,237
Natal	20,461	42,759	512,817
Pondoland	3,869	100	200,000
Zululand	8,900	548	145,336
Amatongaland	5,300	.....	80,000
Basutoland	10,293	578	218,324
British Bechuanaland	60,777	5,284	55,122
Bechuanaland Protectorate	386,200	500	110,000
Brit. Mashonaland (Rhodesia)	150,000	2,500	250,000
Orange Free State	48,326	77,716	129,787
Transvaal	113,642	160,000*	649,560
Swaziland	8,000	500	63,000
	1,037,070	667,472	3,564,183

For the trade tables which follow, the writer is indebted to the "British and South African Export Gazette," an ably conducted paper, published in London in the interest of South African commerce.

The aggregate trade, both imports and exports, of South Africa in the past five years, amounted to about £220,000,000 sterling. This includes an approximate calculation of the 1898 figures. Of this total, the imports of oversea goods represented a sum equal to £108,855,340, and these were imported into South Africa through its several ports in the following proportions:

Ports of Cape Colony	£ 77,623,022
Ports of Natal	21,348,222
Ports of Delagoa Bay	9,883,196
Quinquennial total	£108,855,340

Of this handsome total Great Britain's share in the export of

* A white population of 300,000 was generally credited to the Transvaal up to the time of the recent troubles, of which from 70,000 to 90,000 was accorded to Johannesburg.

purely British and Irish goods and manufactures was represented by £62,801,203, and that of the British possessions by £5,799,783, or together £68,600,986, the balance, in round numbers, of £31,000,000, being the contribution of all other countries. The progressive yearly accretions by which these totals have been reached are shown by the following tabulations:

GREAT BRITAIN'S QUINQUENNIAL SHARE OF SOUTH AFRICAN TRADE.

1894	£ 8,766,828
1895	11,167,995
1896	14,798,430
1897	14,648,162
1898 (approximate)	13,419,848
Quinquennial total	£62,801,223

QUINQUENNIAL SHARE OF BRITISH POSSESSIONS.

1894	£ 605,561
1895	997,558
1896	1,261,504
1897	1,235,160
1898 (approximate)	1,700,000
Quinquennial total	£ 5,799,783

QUINQUENNIAL SHARE OF FIVE PRINCIPAL FOREIGN COUNTRIES.

1894	£ 1,414,565
1895	2,188,247
1896	4,432,428
1897	4,503,366
1898 (approximate)	5,500,000
Quinquennial total	£18,028,606

The relatively large proportion of a little over one-third of the total trade of South Africa which falls to foreign countries is explained by the fact of the heavy imports in recent years of grain, foodstuffs, and live and dead meat, necessitated by the drought and rinderpest and the devastations of locusts, which have afflicted her agricultural and herding industries for several years past. The extent of this huge oversea buying of British and foreign goods would manifestly be impossible unless South Africa possessed purchasing "media" for their acquisition. These are furnished her by her rich and practically inexhaustible stores of native gold, diamonds and other minerals, wool and other raw products.

The imports into the Cape Colony amounted approximately to £16,845,955 at the end of 1898, having made an average advance of over £5,000,000 since 1894—in fact, if compared with the figures for 1897, an actual advance of £7,000,000. In the same quinquennium Natal's imports showed progress from £2,316,596 to approximately £5,127,887, or an enhancement at the handsome rate of 121 per cent. This was even more than the relative progress of either the South African Republic or the Cape Colony, the latter gaining only 49 per cent., and the former 61 per cent. on the earliest year. It is noteworthy that the former's total—£54,332,227—is nearly exactly half of the aggregate of South African imports, and shows the overweighting factor the Republic forms in the commercial expansion of the sub-continent. The appended comparison of the percentages of progress of the trade of the past quinquennium of India, Canada, Australia and the colonies of the Cape Colony, Natal, and Rhodesia, and the South African Republic is given by The Gazette:

QUINQUENNIAL PROGRESS OF OTHER BRITISH POSSESSIONS AS COMPARED WITH SOUTH AFRICA.

	Rate of Quinquennial Progress.
South Africa—	
Natal	121.0 per cent.
Rhodesia	94.0 per cent.
South African Republic	61.0 per cent.
Cape Colony	49.0 per cent.
Other British Possessions—	
Australia, Tasmania, New Zealand, Fiji	40.0 per cent.
Dominion of Canada	8.0 per cent.
India (including Burmah, Straits Settlements, and Ceylon)	per cent. 0.2 per cent.
Average for South Africa	71.0 per cent.
Average for other British Possessions	16.0 per cent.

The ratio of progress in imports alone of South Africa compared with those of our chief colonies and dependencies—India, Australia and Canada—is not less instructive. As against a total for South Africa of £108,000,000, Canada has only an import volume of £26,000,000* to show, and Australia of £97,000,000; while the vast continent of India only surpasses South Africa by her £157,000,000 of imports in the five years.

W. Bleloch, in a paper recently read before the Geological Society of South Africa, confirms the theory first propounded by Dr. F. G. Becker, of the United States Geological Survey, that the Witwatersrand gold-bearing rocks are due to the formation of a series of sub-shore deposits banked up by ocean currents and waves against a sloping shore. At first sight this is only of interest to geologists and mining experts. If, however, it should be confirmed by subsequent tests, it will have far-reaching effects upon the Rand gold mining industry, and equally upon commerce. For instance, payable reefs should exist under the major portion of Johannesburg itself, whilst the Main Reef series would be found underlying the overlaps of more recent beds from Vlakfontein to Venterspost, thereby opening up an enormous area of country for mining purposes, and extending the life of the Rand as a gold producing centre far beyond the 100 or more years already predicted for it by the world's leading experts. It is estimated by Frederick H. Hatch, in the "Engineering Magazine," of New York, that within the next five years the number of stamps in the gold mining district of the Witwatersrand will be increased to over 12,000. The average duty of a stamp here is 1,500 tons per year, or a total of 18,000,000 tons, which, at the present grade of 9 to 10 dwts. of fine gold, or 40s. per ton, would give £36,000,000 sterling per annum.

The coal deposits of the Transvaal are estimated at 235,000,000,000 tons, or 37,000,000,000 tons over those of the coal beds of Great Britain.

Since the first edition of this pamphlet was issued, the writer has received a copy of a New York publication, giving a summary history of the Transvaal. The compiler of this history, which is evidently derived from Boer sources, says that "in 1881 the suffrage in the Transvaal was open to anyone who had lived in the republic two years: but when the British part of the population, which had been voting and holding offices, refused to take part in the defensive war against the Kafirs, on the plea that they were British subjects, and so could not be drafted into service, the Boers, who then far out-numbered the foreigners, passed a law making a renunciation of all other sovereigns a pre-requisite to citizenship in the Transvaal."

This statement of the case, which contains as many inaccuracies as could possibly be crowded into a single sentence, is another illustration of the way in which the Boer authorities have tried to make black appear white to the uninformed outside world. Without going into all the misconceptions in this statement, it will be sufficient to point out that when the Boers undertook their most unjust and unprovoked war against the Swazis, an independent tribe dwelling beyond the Transvaal boundary, they proceeded to commander British sub-

NOTE.—The author has to thank Mr George Hague, General Manager of the Merchants Bank of Canada, for calling attention to a mistake in the above figures by which the S. A. *Gazette* has done a great injustice. Mr Hague says, "In that admirable little pamphlet—(I hope you have sold thousands of them), there is a curious mistake about the imports to Canada. There imports are given as £26,000,000 for five years, whereas the actual imports for one year only—the last of the quinquennial period—amounts to that sum. The total for the five years is over $520,000,000, or £107,000,000, and the rate of increase is not 8 per cent but 37 per cent. The Transvaal imports include the prodigious sums spent in cannon, rifles and other war material.

jects and other Outlanders. The British subjects in particular stoutly objected; "No," they said, "as long as we are denied the rights of citizenship, we shall refuse to fight the battles of the Transvaal. Give us the burgher's rights, and we shall gladly fulfil the burgher's duties; but while we are denied the franchise, we are not going out to fight under the status of galley-slaves." This was the only attitude that a self-respecting man could take, yet the Boer Government actually forced a number of British subjects to go to the front and serve without compensation, and the outrage would have been carried to greater lengths if the British Agent had not made an emphatic protest in the name of the Imperial Government. In the face of these facts, the Boer Government has tried to twist this question completely round and to make it appear that the franchise was afterwards refused because British subjects would not fight for the Republic; whereas, it was just because they were denied the burgher rights that they declined to do military service, especially in a war undertaken to despoil an unoffending tribe.

While most of the habitable areas of North and Central Africa are not favorable to Anglo-Saxon colonization, but are only capable of government on the plan of British government in India and Egypt, almost every region of South Africa possesses a climate in which European settlers thrive, as the experience of British and Dutch for over a hundred years has amply shown. There are several varieties of climate in South Africa, but generally speaking, their nearest parallel on the American continent is to be found in Northern and Southern California and Colorado. Along the coast of Natal and the eastern coast of the Cape we have all the sub-tropical products, such as bananas, pineapples, oranges, tea, coffee, cotton, etc., while in the midland regions of Natal and the Cape we find some of these products, with peaches, pears and many of the fruits and grains of the temperate zone; and again, on the plateaus and plains of Upper Natal, the elevated lands of the Cape, the Free State and the Transvaal, we find the fruits, vegetables and grains of England or Canada. Again, in the lowlands of the Transvaal and neighboring states we have a warmer climate, and some tropical products, like the middle and lower districts of the Cape and Natal. Being in the southern hemisphere South Africa has its summer when Canada has its winter, and instead of spending Christmas round the fireside the Natalians and Cape Colonists celebrate that season by picnics and outdoor festivities. Although two or three crops of vegetables and of some kinds of grain can be raised in a year, and vegetation never ceases, except in prolonged droughts, there are properly only two seasons in most parts of South Africa—the rainy and the dry

—The report of the annual meeting of the Association of Ontario Land Surveyors, containing portraits and biographical sketches of the new officers, has been crowded out of the present issue, but will appear in May.

—The numerous manufacturers, especially those in the machinery line, who have for years had increasing cause of dissatisfaction with the drift of things at the Toronto Exhibition, have all reason to thank J. O. Thorn, of the Metallic Roofing Co., for taking up their complaints and fighting for their interests against that clique in the board of directors who are responsible for the moral degeneration of Canada's great show. Many individual complaints have been made to the "Canadian Engineer" that the circus and peanut departments have received the lion's share of attention, while the reasonable requirements of the manufacturer have been ignored. A large number of foreigners will come over to Toronto from the Pan-American Exhibition at Buffalo next year, and there is yet time to make the reforms needed for a really good exhibition in 1901. If those of the exhibition directorate who really care for the future of this institution could see the stacks of letters Mr. Thorn has received, they would cease their silly attempts to laugh down these complaints, and would come down from their kopjes at once. We do not suppose there is any general desire to depose Mr. Hill. He is an energetic and capable exhibition man, and with a different set of men to work with would no doubt make the reforms needed to redeem the character of the show. As an example of the feeling of manufacturers in this matter we understand that nearly all the makers of agricultural implements have agreed to withdraw from the exhibition altogether, though we suppose they would reconsider this step if the directors made a "right-about face."

THE USE OF BOILER COMPOUNDS.*

BY ALBERT A. CARY.

(Concluded from last issue).

Next, turning to the sulphates of lime and magnesia, we find them very soluble, dissolving in water direct, without requiring the presence of carbonic acid or any other foreign agent. The amount of sulphate of lime which can be dissolved in one United States gallon of water at different temperatures may be appreciated by examining the following table:

At 32° Fahr. 120 grains per gallon.
At 95° Fahr. 148 grains per gallon.
At 212° Fahr. 127 grains per gallon.
At 250° Fahr. 9 grains per gallon.
At from 260° to 302° Fahr. it is practically insoluble.

This latter temperature (302 degrees) corresponds to 55 pounds gauge pressure, and, therefore, when water is thoroughly boiled at this temperature, practically all of the sulphates will be precipitated. The crystals of sulphate of lime will be found to be long and needle-like, and also very heavy and possessing cement-like qualities, so they fall rapidly, and, mixing with the precipitated carbonates, they bind them together into a hard, resisting mass, difficult to remove with even hammer and chisel, if they form a considerable proportion of the scale. It is here where the active agent in the compound is supposed to take effect, and by referring to the reaction given above—in the formulae (a) and (b)—when the carbonate of soda is used, it will be seen that the sulphates of lime and magnesia are changed into carbonates, which are precipitated and form a scale varying from a more or less porous, friable crust to a "mush" or mud. The sulphate of soda which is also formed by this reaction is extremely soluble, remaining in solution at nearly all boiler temperatures and forming no scale, unless allowed to concentrate, and this is prevented by "blowing off" occasionally

The tannin matters, referred to above, are obtained from various vegetable sources containing tannic acid, such as certain kinds of sumac, gallnuts, catechu (or cutch) bark, etc. Tannin is generally combined with soda to form the tannate of soda for use with boiler waters to keep the deposit soft or in suspension. Its action is supposed to be as follows: The tannate of soda decomposes the carbonates of lime and magnesia as they enter the boiler, and tannates of lime and magnesia are precipitated in a light, flocculent, amorphous form and are long kept in suspension by the circulating currents of water, until they finally are deposited in a loose, mushy mass in that part of the boiler where the circulating currents are the weakest or possibly in the mud drum. When the above reaction takes place the carbonate of soda is formed, which reacts with any sulphates that may be present, as has already been described. The use of tannic acid in the boiler cannot be recommended unreservedly as it will attack the iron as well as the carbonates (although, of

*Reprinted from the American Machinist

course, more slowly), and anything that will corrode the boiler itself certainly cannot be desirable. To test this, anyone can obtain a few cents' worth of tannic acid from the druggist, and by dissolving the crystals in a glass of water and adding some iron filings, a very fair quality of ink can be made, due to the action of this acid on the iron.

In practice, the reaction of caustic soda ($Na_2O_2H_2$) with the sulphates seems to be more active than when the carbonate of soda is used, the probable reaction being as shown thus:

Sulphate of Lime	and	Carbonic Acid	and	Caustic Soda
$CaSO_4$	+	CO_2	+	$2NaOH=$
		form		
Caustic Lime	and	Carbonic Acid	and	Sulphate of Soda
CaH_2O_2	+	CO_2	+	Na_2SO_4

The carbonic acid used in this formula results from the precipitation of the mono-carbonates from the bi-carbonates, as has been explained.

The secondary reaction from the result just arrived at is as follows:

Caustic Lime	and	Carbonic Acid
CaH_2O_2	+	$CO_2=$
	form	
Carbonate of Lime	and	Water
$CaOCO_2$	+	H_2O

The use of caustic soda may be considered less desirable than the use of the carbonate of soda for several reasons. In the first place this present in excess will cause violent foaming in the boiler, and with this foam often the light precipitated matter in the boiler will be carried along steam pipes into valve seats, gauge glasses, etc. It will also attack and cause corrosion of the brass fittings, and it is also dangerous to handle, owing to its caustic qualities, burning the flesh painfully wherever it comes in contact. An excess of carbonate of soda may also cause foaming in the boiler, but not as violent as when caustic soda is used.

Sal ammoniac (i.e. ammonium chloride) (NH_4HCl) is most undesirable for use in a boiler, due to the liberation of hydrochloric acid (HCl) following its introduction into the boiler. This acid leaves the boiler in a vaporous form, with the steam, corroding boiler, piping and nearly everything it comes in contact with. There are other "compounds" falling under this classification, of known chemical composition, which are more satisfactory than those named above, such as bi-sodium phosphate and tri-sodium phosphate, the latter being obtainable in both a hydrous and anhydrous state. The latter is less bulky and its reaction with the sulphate of lime is shown by the following formula:

2 Parts		3 Parts
Tri-Sodium Phosphate	and	Sulphate of Lime
$2Na_3PO_4$	+	$3CaSO_4=$
	form	
		3 Parts
Phosphate of Lime	and	Sulphate of Soda
$Ca_3(PO_4)_2$	+	$3Na_2SO_4$

The phosphate of lime, after this reaction, falls, forming a slushy mud, making at the most a very weak crust, while the sulphate of soda remains in solution, as previously described. The fluoride of sodium is another "compound" of known composition, which has also proved satisfactory, especially when much sulphate of magnesia is present; its reaction with the sulphate of lime being as follows:

2 Parts of		
Fluoride of Sodium	and	Sulphate of Lime
$2(NaF)$	+	$CaSO_4=$
	form	
Fluoride of Lime	and	Sulphate of Soda
CaF_2	+	Na_2SO_4

The fluoride of lime precipitated in the boiler behaves much like the phosphate of lime just described, while the remaining sulphate of soda is found in solution, as stated above.

Our second division of compounds includes a class of materials which are gradually falling into disuse due to their proved undesirability. They thicken and foul the water in the boiler and coat its surfaces with non conducting material, and occasionally the precipitated scale making matter, along with this class of compound, will obstruct the passage of heat through the boiler plates, so as to cause bagging and burning. In this class we find slippery elm, ground bones, horns and animals' hoofs, potatoes, dextrine, and starch, animal fats and animal or vegetable oils. As rapidly as the scale-forming crystals are precipitated from the feed water, they fall into this sticky cooking fluid and become coated with its filth, and they finally fall to the place of deposit, where they remain in a mushy, separated state until the organic matter chances to be burned out, when they will form into a loose, friable scale.

A surface blow-off or skimming device is most essential to reduce the evil, when this class of compound is used, and the bottom blow-off cock should also be opened very frequently.

We now come to our last division of this subject. The principal substances used for this third class of compounds are petroleum and kerosene. Petroleum oil has much more of the enveloping quality described under the last (or third) classification than the kerosene. Besides producing this effect on the scale matter, both have an active rotting effect on the scale already formed, the kerosene in this case being superior to the petroleum. Crude oil should never be used, but a carefully refined oil, which has been deprived of its tar or wax, should be selected for this purpose, as these cause the formation of a tough, impervious scale productive of bagged sheets and collapsed flues. Petroleum or kerosene should be fed to the boiler with the feed water, drop by drop, through a sight-feed apparatus similar to those used to feed oil to the cylinders of engines. There are several forms of this apparatus on the market. Under no consideration should large amounts of these oils be fed to a boiler at one time, as it must be remembered that the more volatile portion of the petroleum will be quickly distilled off in the hot boiler, leaving the least efficient portion behind, while the more volatile kerosene will be vaporized very quickly, before it has time to thoroughly mix with the water.

Where hard scale has formed in a boiler, it is most effectually treated by giving it a coat of petroleum or kerosene, to partially dissolve or rot it. These may be applied with a brush or squirted on, but an easier method of application is to first fill the boiler with water above the line of scale deposit and then pour the oil on the surface of this water, and let the water gradually run out of the bottom of the boiler, thus leaving the oil behind clinging to the whole interior surface. As stated above, kerosene is the most effective in destroying the tenacity or coherence of this deposited scale, but this method of using either oil is not without attending danger, on account of the explosiveness of the vapor given off; so great care must be taken to have no lights in the vicinity of the boiler under such treatment, as men have been seriously injured by this lack of prudence. The treatment of feed waters inside of the boiler has been a practice of many years' standing, but in the light of recent progress is not to be commended. A boiler certainly has all that it can reasonably be expected to do when it is generating steam, without being called upon to perform the functions of a chemical laboratory. Everyone knows that when a new boiler is started it "steams lightly" and is most economical in its use of fuel, but generally after it has been in service for some time harder firing is necessary and larger fuel bills appear. Following this reasoning, I would ask if it is not far more sensible to keep the boiler constantly up to its original state of efficiency by preventing the scaling and corrosive agents from entering it, rather than accepting such evils and trying to correct them after they have occurred?

The external method of treating feed water, chemically or mechanically, is being adopted by many progressive plants in this country; and in this, I am sorry to say, Americans are far behind the English, French, Germans, Belgians and Austrians, in whose countries the external treatment has been largely and most successfully practised for many years. There are, of course, plants where the internal treatment of feed water is an enforced necessity, owing to surrounding conditions or lack of funds necessary to install apparatus for external treatment, but as such apparatus has invariably proved to be an excellent investment, it should receive careful consideration from all steam users.

Before closing I feel that I must add something in the way of warning to the users of boiler compounds. Owing to the unfortunate fact that boiler users have, as a general thing, been too busy to give this important matter of scale and corrosion a proper amount of study, they have become the victims of

more imposters than exist in almost any other branch of trade. The boiler quack comes along with his remarkable boiler compound, fluid or special apparatus, and without the slightest knowledge of the character of the impurities held in your boiler feed water, he offers his panacea with a long list of letters of recommendation, written often by the heads of concerns who are far better acquainted with the financial end of their business than with the steam plant equipment. These gentlemen generally depend upon what their engineer or other employees tell them. The writer knows of not a few cases where the unscrupulous vendors of certain compounds share their profits with these engineers, firemen or other influential employees, which they can well afford to do, as the stuff they sell seldom costs a fifth of what they get for it. These unscrupulous people, their methods and their wares have been "shown up" from time to time in the technical and trade papers, and they have not escaped the well-directed fire of the Hartford Steam Boiler Inspection and Insurance Company.†

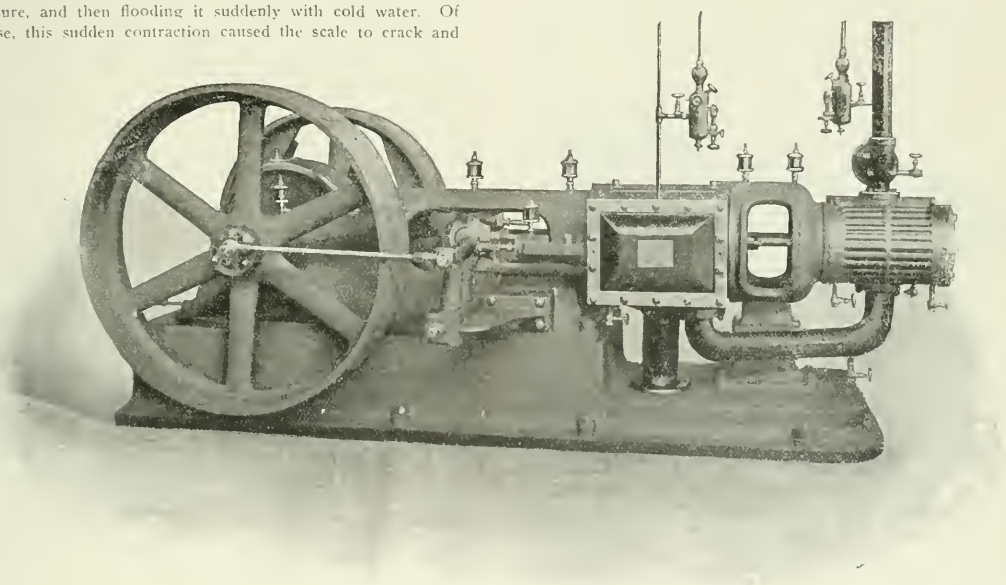
They are often very tricky manipulators, able to give an apparent exhibition of the wonderful disincrusting power of their purges. I caught one at one time cracking the scale out of a boiler by blowing it empty of its water, under steam pressure, and then flooding it suddenly with cold water. Of course, this sudden contraction caused the scale to crack and fall off, but a boiler maker had a nice little job afterwards in making the boiler tight. In another case I found that one of these manipulators had about ruined a boiler by first giving it a dose of muriatic acid before introducing his "compound." These are but two examples of the many tricks resorted to.

The best advice I can offer on this subject is: Never use any boiler compound, fluid, powder or whatever else it may be called, unless you know positively just what it is composed of and how it will affect the impurities in your boiler water and the boiler itself. Many of these quacks pretend to have made a chemical analysis of the water to be treated. This is frequently a mere farce, as the same old compound is trotted out on all occasions. Some submit to their proposed victim what purports to be an analysis, of their feed water. Many a time a subsequent bon-fide analysis, made by competent chemists, has proved to me the absolute worthlessness of these first supposed analyses. In the treatment of boiler waters always start with a careful analysis of the water, made by a competent chemist experienced in this line of work. Next, let an expert in this line of known reputation, and one who is not in any way interested in any method of treatment, suggest the best method of treatment; or should you think of using any "compound," fluid or powder that has been offered for treatment of your boiler water, let this chemist analyze it. If you are dealing with straightforward people, they will tell you the exact composition of their material, which the chemist can verify easily, after which the chemist or expert is prepared to advise you properly.

† See "The Locomotive," Vol. V, page 59 and Vol. XV, page 90.

THE M'EWEN AUTOMATIC ENGINE.

The first McEwen automatic engine was placed on the market in the spring of 1891, and during the eight years which have passed since then, hundreds of these engines have been manufactured and put in operation. They can now be found in operation in all parts of the United States and throughout the Dominion of Canada and for almost every conceivable kind of service. Its makers claim that no engine ever placed on the market has been more uniformly successful in operation, or has better withstood the test of time. While the design of this engine is practically the same to-day as when it was first placed on the market, improvements have been made on the minor details which have kept it fully abreast of the times. Originally designed particularly for simplicity and strength these very important qualities have been carefully kept in view in making later improvements. The character of the workmanship has been steadily improved, and the McEwen engine, as built by the Waterous Engine Works Co., at the present time, is as carefully and thoroughly constructed as any first-class, high-speed engine built anywhere in America. The engine is claimed to have fewer parts than any other engine of this type built anywhere in the world, and for qualities of strength, durability, economy and smoothness of running, it is unexcelled. On the one point of regulation the McEwen engine from the start established a standard, which, in spite of the many imitations by competitors, is said to never have been reached by any other engine in the world. All parts of these engines are made interchangeable, every piece being made to gauge, so that, if for any reason any part needs renewing, it can be supplied from stock, with the assurance that it will fit. All bearing surfaces are unusually large, and are carefully scraped and fitted to surface plates. Every piece is required to pass through the inspector's hands after every operation before passing to the next workman. Under this system it rarely happens that any defective work reaches the testing block, and here, as during the progress of the work, the inspection is rigid. Every engine is carefully and systematically tested before shipment, under conditions as nearly as possible approaching its future working conditions. The valves are set and carefully adjusted by means



The M'Ewen Automatic Engine

of the indicator and the regulation by means of an accurate tachometer. The bearings are all carefully adjusted and the engines operated for at least a whole day under loads varying from zero to one hundred per cent. overload.

The McEwen engine is a high-speed engine designed especially for extremely close governing under the severest and most rapid fluctuations of load—such as are met with in the driving of electric generators for electric lighting, electric railway service, mine haulage, electric crane work, etc. The accompanying illustration shows a compound McEwen engine, built by the Waterous Engine Works Co., Brantford, Ont.

ROLLER AND BALL BEARINGS.*

BY J. B. DETWILER, BRANTFORD, ONT.

The subject is a very extensive one and is the cause of a great deal of correspondence in our leading mechanical and scientific journals. No department of mechanical design or construction has received more careful consideration than that of roller and ball bearings. Very rapid strides have been made recently in the perfecting of roller bearings, making their employment more common. We read of roller bearings having been used 25 years ago, but with little success, owing chiefly to the way they were constructed, and it is only within the last few years that they have been so constructed as to make them practicable. For many years the only successful application of rolling motion to bearings was the ball bearing so universally adopted in bicycles, and although these bearings have been found most satisfactory when subjected to light loads, all attempts to apply them to heavy loads have so far resulted in failure, arising chiefly from the balls indenting the races upon which they run. As soon as this takes place, the balls begin to lose their friction reducing properties. If a semi-circular trough be constructed which accurately fits a ball and one end of the trough be raised, it will be found that the ball will move by sliding and not by rolling; this is indentation carried to the extreme. Another defect in the ball bearing is that the balls are allowed to touch each other, and as the touching point of any two balls are revolving in opposite directions, there must be a certain amount of friction. The same error in the construction of roller bearings was made until cages were introduced. These cages serve the double purpose of keeping the rolls in alignment with the axis of the shaft and of keeping them separated from each other, doing away with the friction caused by the touching points of the rolls running in the opposite directions as is the case of ball bearings. Judging from the various size of balls used in bearings, one might be led to suppose that ball bearings knew no law.

A few years ago very small balls were used, but they proved very unsatisfactory, for cones and cups were soon destroyed and had to be renewed. The same error was made in roller bearings, and when the cages were introduced, and less rolls used in the same size bearing, larger rolls had to be used to bear the same load. Those who advocate the use of small balls, and the same argument holds good with rolls, argue that as the balls bear on a point, and as more small balls can be placed in a bearing of a given size than large ones, there are more points of contact, and the result, a more durable bearing. The error in this argument is, in assuming that a ball or a roller bears on a point, which is not the case, excepting when working under a very light load, but when the bearing is loaded, the rollers or balls are slightly compressed and the very slightest compression causes the point of contact to enlarge. If a large roller or ball is compressed, to the same extent, the point of contact will be greater than in the case of the small roller or ball, because the larger the sphere the flatter the curve. Tests have been made to prove beyond doubt that the carrying capacity of rollers and balls is as the squares of their diameters, in other words one ½ inch ball or roller will carry as heavy a load as four ¼ inch ones. The writer has made tests with loading ¼-inch rollers in bearings until the weight was sufficient to elongate the rolls by rolling them out, and thus reducing the size, and in a very short time rendering the bearing useless.

The question is very often asked, how much do roller bearings reduce friction or how much less power does it require to run a shaft fitted with roller bearings than one fitted with ordinary bearings. While there is very little reliable information on this point, experiments have shown that friction increased little if any, with the increase of pressure, and that the friction increased considerably less than the proportion of the square root of the speed. In tests made by Geo. F. Symons it was shown with bearings 2½-inch in diameter that the friction developed was from .0025 to .005; these figures were obtained under comparatively light loads. In comparing ball bearings with babbitt bearings, it was found that under 200 lbs. pressure to the square inch, and 800 revolutions per minute, babbitt bearings 2½-inch in diameter lubricated with 20 drops of oil per minute, and having a ½-inch lateral play, heated badly. Under the same pressure ball bearings were running at 2,600 revolutions per minute, or more than three times as fast, without signs of heating. The American Machinist of October 17th, 1895, gives the following: "The first was in the shop of Brown & Sharp, where a set of rolls used for rolling sheet steel, cold, were first operated for some time with ordinary bearings, previous to the change, a 6-inch belt running over a 24-inch pulley on a machine had been found inadequate to drive it, and a 4-inch belt had been placed over it. The two belts arranged in this way had driven the machine, but it had been found impossible to run more than a few hours at a time on account of the heated bearings. After putting in the roller bearings it was found that a 1-inch belt would drive the machine when doing the same work, and we recently saw a 2-inch belt driving the machine, and were informed that it was regularly used, running on the same pulley. It had been found unnecessary to stop on account of hot bearings, and the speed had been increased 25 per cent." There is here shown such an enormous advantage in the use of rollers, as to make the plain statement of the facts seem like a fairy tale, but we can vouch for its accuracy in every particular. It shows that a very great advantage may be gained by roller bearings in some cases, and also shows that a very large proportion of the total driving power applied to rolls when used on such work is consumed in overcoming frictional resistance in the machine. The pressure required to slightly reduce the thickness of a strip of hard tool steel 6 in. or 8 in. wide is, of course, very great, and the actual foot pounds of energy required to do it, must be small. The consequence is that the great pressure upon the bearing causes corresponding frictional resistance in them which consumes practically about all the power applied to the machine, and this gives to the roller bearings a chance to make perhaps the very best possible showing. In a machine where the actual work to be done required more power, and the frictional resistance less, proportionately, the showing might be expected to be very different. Such a case, and one more nearly representing the average condition under which comparisons will be made, is to be seen at the establishment of the Gilbert Clock Co., at Winstead, Conn., where there are 600 feet of line shafting, having 104 bearings of the usual type, lined with babbitt metal, and these bearings were replaced by roller bearings. The shafting is driven by a 40 h.p. water wheel and, according to the brake or dynamometer tests made 25.02 h.p. of this was absorbed by the frictional resistance of the line shaft when using the old bearings as against 18 h.p. with the roller bearings, thus saving 7.02 h.p. or 17.55 per cent. of the whole power developed by the wheel, and 28 per cent. of the original friction of the shaft. Fourteen Mossburg roller bearings were on June 29th, 1897, applied to a 3-inch shaft, 80 feet long, running 200 revolutions per minute, and subjected to careful and repeated tests which showed a saving of more than 50 per cent. in power required to overcome the friction of the shaft running in babbited bearings. The shaft had been thoroughly tested when running in the ordinary babbited boxes, and found to consume by friction, when running at full speed, 0.21 h.p., and to come to a standstill in two minutes after being disconnected from the source of power. Similar tests were made after the shaft had been fitted with roller bearings; the power required to overcome the friction being found to be only 3.01 h.p. and the shaft revolved ten minutes after being disconnected from the source of power. The bearings have been in use six months, running 22 hours every day, and are in first class condition, showing little wear, and giving very little trouble. From an article taken from The Canadian Engineer, on roller bearings, by W. Bayley Marshall, C.E., we learn the result of the following test. A passenger train of six carriages fitted with roller bearings throughout, has been running for

*A paper read before the Mechanical Superintendents' Association.

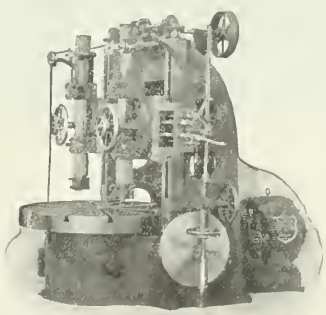
two years between Brighton and Kemptown with a total mileage of 70,000, and has shown a saving of from 12½ to 15 per cent. in the consumption of fuel, which saving has been obtained under most disadvantageous circumstances, inasmuch as the engine has to be kept in steam for about 16 hours per diem, whilst its actual running time is under seven hours. The tramway car, fitted with ordinary bearings, and weighing 2 ton, 15 cwt., was let loose from a point 56 feet up an incline with 1 foot 6¼-inch rise; it ran down this incline, and 57 feet on the level line at foot of same, or a total distance of 113 feet, the force expended was therefore 6,160 pounds, falling through 1.521 feet or 9,364 ft. lbs., the average frictional resistance was 9.364 divided by 113, or nearly 83 pounds, equal to 30.5 pounds per ton. A similar car fitted with roller bearings being let loose from the same point ran the full length of the level line available, namely 320 feet, and had not then quite come to rest. The total distance traversed being 376 feet. The force expended was about 9,364 feet pounds, average frictional resistance was 9.364 divided by 376, equals 24.9 pounds, or about 9 pounds per ton of load, a saving of 72 per cent. Relative starting effort of a tram-car on a gradient of 1 in 20; ordinary bearings, 100; roller bearings, 77; saving 23 per cent. on a gradient of 1 in 80; ordinary bearings, 100; roller bearings, 50; saving 50 per cent. on a gradient of 1 in 140; ordinary bearings, 100; roller bearings, 39.6; saving 60.4; results which require no comment.

Perhaps one of the most interesting among the general application of these bearings is that of the big bell at St. Paul's Cathedral, London, Great Paul, which with its head stock and other moving parts weighs nearly 25 tons, and which gave considerable trouble when mounted on ordinary bearings. The following results are instructive. When mounted on ordinary bearings the bell came to rest after the swinging effort had been discontinued, within one minute, when on roller bearings 6 minutes 55 seconds, showing that the frictional resistance of the latter was only about 1-7 of the former; a result remarkably in accordance with the starting effort tests given under the head of tramways.

With reference to the question of heating, it is an interesting fact that there has not been a single case of a hot bearing in all the experience so far gained with roller bearings. Although it is somewhat early to predict what the cost of maintaining these bearings will be, the results so far show that if they are constructed of suitable material, it will be extremely low. It has been found that polished and pressed steel or cold rolled steel is the best material for the rollers, and the boxings lined with steel have been proven by the writer to be far superior to cast-iron boxings. In all cases, if at all convenient, the boxings should be of the oscillating type to ensure perfect alignment.

SLOW SPEED MOTORS DIRECT CONNECTED TO MACHINE TOOLS.

One of the most important applications of electricity now-a-days is its employment to distribute power from the prime mover to the various machines to be operated. In this way a

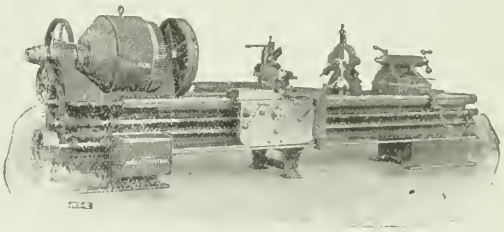


Motor Direct Connected to Boring Mill.

plant can be enlarged at small expense by the addition from time to time of motors as the machines required to be driven are installed. There are now many factories in this country which are equipped with slow speed motors directly attached to the driving shaft of all sizes and types of tools, the motors being part of the tools themselves. These motors do not at all interfere with the operations of the cranes now found in every well appointed factory by preventing them from dropping the piece into the tool itself. Great advantage is claimed to exist in cases in which electric driving by direct connected motors are used on machines required to be driven intermittently.

Among the advantages of direct connected motors is that of cost, as the price of a motor depends as much on its speed as on its horse-power. For instance, there is quite a difference in the price of two motors of equal horse-power, one geared to the tool and running at say one thousand R.P.M., and the other mounted directly on the driving shaft of that tool and therefore running at the same speed, which may be as low as one hundred R.P.M. In the case of the geared motor its speed is too high to attach directly to the tool, and hence reducing gears have to be used, which is a somewhat uneconomical and noisy method of driving, besides requiring more floor space for the motor. The makers of slow speed motors urge that the cost of these gears or the speed-reducing devices must not be lost sight of in making the comparison.

Some of the advantages claimed to be obtained by the use of direct connected slow speed motors are: All expense for power ceases the instant the switch is opened and the motor stopped; the tool can be located anywhere irrespective of lines of shafting;



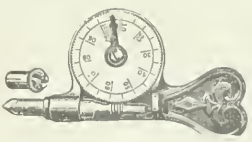
Motor Direct Connected to 26 in. Engine Lathe.

a much higher rate of output for the tool and machinist is possible; these motors occupy the space and take the place of the driving pulley on the tool; they are compact, protected from injury, moisture and dust; tools thus equipped can generally be run after the engine has shut down by connecting through a switch to the mains of a local central station; special tools equipped with direct connected motors may be moved readily to the piece they are to do the work on; the exact amount of power used by each tool can be accurately measured at any time by the use of instruments indicating electric current; the life and usefulness of a motor is greatly increased by running it at a slow speed; the use of electric transmission permits the generating units to be large, and to be concentrated near the boilers at that point most convenient for handling the supply of fuel.

The Jones & Moore Electric Co., Toronto, is Canadian agent for the Bullock type of slow speed motors.

SPEED INDICATORS.

Woodman's and Hudson's patent improved speed indicators, manufactured by the R. Woodman Manufacturing and Supply Co., 63 Oliver street, Boston, Mass., U. S. A., are now attracting a great deal of notice. The attention of dealers and others using and selling machinery is invited to the qualities which



combine to make this indicator, its makers claim, preferable to any other in use. It is adapted to pointed or hollow centers and has a raised sight on dial so as to count by touch, which is of great importance, especially in dark places, as it is only necessary to look at your watch and count the number of revolutions the dial makes, which, with the fractions, will be the exact speed

of the machine. It is accurate, reliable, of convenient size, neatly finished, and suited to carry in the pocket. The spindle is made of best tool steel.

THE CANADIAN ASBESTOS COMPANY.

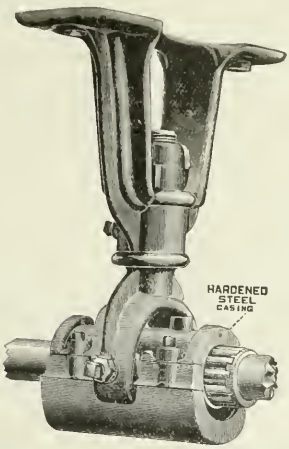
The Canadian Engineer was the first technical journal to call attention to the advantages of "Asbestic" (asbestos) as a wall plaster and a fire-proof material for interior work in buildings, and it is satisfactory to know that time has fully justified the predictions made for it when introduced about four years ago. We learn from the Canadian Asbestos Co., of Montreal, who are sole manufacturers of this material, and whose principal warehouse is here illustrated, that 10,000 tons of asbestic were sold last year, and the output is increasing year by year. The original factory at Danville, Que., which was destroyed by fire the other day, is being rebuilt on a large scale and will be

CANADIAN ASBESTOS CO.
ASBESTOS STEAM PIPE & BOILER COVERING ASBESTOS PAPER & PACKING
COTTON WASTE, OILS & SUPPLIES
CANADIAN ASBESTOS CO.
ASBESTIC WALL PLASTE
ASBESTOS ROOFING
WILLIAM SCLATER PRES'T
CANADIAN ASBESTOS COMPANY

equipped with new machinery. The company now have 350 local agents throughout Canada, while asbestic plaster is used in the most modern structures now being erected in the United States and Great Britain. It has been called for in the reconstruction of the western block of the Government buildings at Ottawa, the hospital in that city, the Donalda College, Stanley Flats, Karn Hall, Her Majesty's theatre and many large private building in Montreal and other cities, while among the new buildings now under construction in Montreal in which it is being used are the publishing houses of La Presse, The Montreal Star, S. Greenshields, Son & Co.'s wholesale dry goods warehouse, Henry Morgan & Co.'s new wing, the St. Jean Baptiste church at Mile End, the municipal and school buildings of Westmount, etc. Among the shipments to distant points which the Canadian Asbestos Co. now have in hand are five car loads of asbestos and roofing paper to Dawson City, Yukon. The catalogue just issued by the company gives illustrations of some of the large structures in Great Britain, Europe and the United States for which asbestic has been adopted, while some remarkable tests are recorded showing the fire-proof, cold-proof, sound-proof and other qualities of asbestic. The same catalogue describes more or less in detail the other products of the company, such as asbestos cement for furnaces, retorts, stoves, etc., asbestos roofing and building papers, asbestos packings, lubricating compounds, mill board, asbestos cloth, fire-proof curtains, ropes, asbestine fire and waterproof paint, boiler coverings, and other engineers' and ship's supplies. The demand for goods of which asbestos is the raw material is so great that this company is about to open out another mine in the province of Quebec to which reference will be made in a later issue. As dealers in raw as well as manufactured asbestos the company supply the principal United States asbestos manufacturers. Our readers may remember a record shipment made by the company last autumn to one of these United States firms, the shipment consisting of 38,000 bags, or five train loads. This is the largest order for asbestos ever filled by any firm in the world. Wm. Sclater, whose jovial face is familiar to nearly every dealer in these lines of goods in Canada, and who may be called the pioneer in the trade, is president and managing director of the Canadian Asbestos Co.; B. Shepherd is vice president and B. Marcuse, who was one of the founders of the original asbestic factory at Danville, is secretary treasurer.

Ogdensburg, N.Y., capital is to put a large light draught boat on between that place and Montreal this season. Passengers and freight will be carried, and it is hoped the single boat will grow into a line.

BRANTFORD ADJUSTABLE DROP HANGER WITH PATENT ROLLER BEARINGS.



This illustration gives a good idea of the patent roller bearings, with outer steel casing, made by Goold, Shapley & Muir Co., Ltd., Brantford. Their advertisement in this issue will be of interest to manufacturers and others who wish to keep posted in mechanical ideas.

ACETYLENE FOR COOKING.

There has been a general impression that acetylene gas does not compare with coal gas or water gas for heating or cooking purposes, but it is the opinion of W. J. Stinson, of the Acetylene Manufacturing Co., of London, Ont., that this impression is because of the crude burners or stoves used in the experiments. In a letter to The Canadian Engineer Mr. Stinson supplies the following interesting information on this subject:

"I may say that I have been experimenting with acetylene, along the line of heating, during the past two years, and have acetylene gas stoves in operation with the most satisfactory results. We have not heretofore pushed this branch of our business to any extent, owing to the scarcity of carbide, but now that we may reasonably expect an abundant supply, we anticipate a very large demand for combination machines for both lighting and heating. The following tests as to cost are typical of a great many that we have made. We have tried to be as fair as possible, and to give no advantage to either acetylene or city gas. The results are what the general public is interested in, and we have tried to put these comparisons in practical form.

"An oven full of slow-baking fruit cakes, etc., was baked in a Detroit Jewel gas stove, in one hour and ten minutes, with a consumption of thirty-one (31) cubic feet of city gas, which at $1 per M. cost three and one-tenth (3 1-10) cents. An exact duplicate of this oven of cakes was baked in one of our regular acetylene ovens, such as we supply to our customers, in one hour and thirty minutes, with a consumption of three and one sixth (3 1-6) cubic feet of acetylene gas, costing two and one-half (2½) cents, with carbide at four (4) cents per pound. A given quantity of water was raised from freezing to boiling point, in five minutes by the consumption of two (2) cubic feet of city gas, costing one-fifth (1-5) of a cent. The same quantity of water was raised from freezing to boiling point, in four and one-half (4½) minutes, by the consumption of one-third (⅓) of one cubic foot of acetylene, costing one-fourth (¼) of one cent. We have made dozens of similar tests, all giving practically the same results. The above estimates have been made on the basis of carbide costing four (4) cents per pound, and city gas costing $1 per thousand feet. City gas is higher than this in most cities and calcium carbide will soon be very much lower than at present. You will notice that in baking acetylene has a very decided advantage, while in the water boiling test, city gas has the advantage. We can probably account for this difference by stating that we use, on our acetylene stoves, a somewhat better oven than is usually found in connection with gas stoves. It needs but a slight reduction in the price of carbide to place acetylene away ahead of coal, water or oil gas, as far as economy is concerned, but economy is not acetylene's only advantage. By its use the disagreeable smell found in connection with the ordinary gas stove is entirely done away with, as acetylene gives off no odor when being burned, either as a lighting or a heating flame. An ordinary gas stove is a more or less smoky, dirty, greasy affair, but an acetylene stove does not smoke, neither is it a grease or dirt producer. The general public admit the decided advantages of acetylene as an illuminant, and it is but a matter of a very short time until it will be looked upon as the ideal heat producer as well."

CANADIAN SOCIETY OF CIVIL ENGINEERS.

THE VISIT TO BOSTON.

The trip to Boston, which was planned as part of the programme of the 14th annual convention of the Canadian Society of Civil Engineers, will long be remembered by all who had the good fortune to take part in it. After the annual business meeting, reported in last issue, the excursionists gathered at Bonaventure station, where by the courtesy of the Grand Trunk Railway Co., and the Pullman Palace Car Co., a special train with three sleeping cars was in waiting to take them to the New England capital. The Central Vermont and Boston and Maine gave the society free running privileges over their lines, and the party arrived in Boston on Thursday morning, February 1st. They were met at the station and cordially welcomed by a deputation from the Boston Society of Civil Engineers, who escorted them to their headquarters at the Hotel Brunswick, where the formal welcome was made by the president of the Boston Society, C. Frank Allen, professor of railway engineering in the Massachusetts Institute of Technology. On behalf of the Canadian society, Prof. Bovey, president-elect, thanked the Boston society for their hospitable welcome.

The first event in the list of Boston excursions was a visit to the Massachusetts Institute of Technology, the visitors being piloted by Desmond Fitzgerald, its professor of civil engineering; Gaetano Lanza, professor of mechanical engineering; Geo. F. Swain, Hayward professor of civil engineering, and C. Frank Allen, professor of railroad engineering. This great institution has grown from small beginnings till it now has four large buildings in which are taught civil and mechanical engineering, mining engineering and metallurgy, architecture, chemistry, electrical engineering, biology, physics, chemical engineering, sanitary engineering, geology, naval architecture and general studies. The various engineering and technical departments are equipped with machinery and testing appliances, many of which are of the most modern description. This school gives the degree of B.Sc., and has 1,200 students. The institution has ten technical libraries, having an aggregate of 47,000 volumes; while it receives 850 technical and trade papers, the largest collection, it is believed, in the world.

In the afternoon the party visited the new south terminal station of the Boston and Albany, and New York, New Haven and Hartford railroads. The station buildings cover 13 acres, the main building being 850 feet long by 725 feet wide. The train shed is 602 feet by 570 feet, and has 28 tracks in the main floor. Beneath this and below tidewater is a subway for suburban service. The switches and signals are operated by the electro-pneumatic system. There is a 2,000 h.p. steam plant for generating electricity and operating the air compressors, ice-making and air-brake testing plants, and a plant for hot air and hot water heating. There is also a plant for making and compressing the gas used in the cars, the capacity being 120,000 cubic feet per day. The station cost $15,000,000, of which $6,000,000 was spent in buildings and plant. Geo. B. Francis, the resident engineer, and A. B. Corthell, the assistant engineer, acted as guides in this interesting visit.

The evening was pleasantly taken up with a lecture under the auspices of the Boston society, by Frederick P. Stearns, chief engineer of the Metropolitan waterworks, on the new waterworks system now under construction. The lecture was illustrated by stereopticon views, and was most instructive. The water supply of the metropolitan area of Boston is derived from a chain of ponds, basins and streams extending from a point about ten miles outside the city to a distance of 50 miles north

west, and running into the highlands around Nashua, where the latest new source of supply is the south branch of the Nashua river. The water sheds of these basins and streams have an area of 212 square miles, with a total daily supply in the driest known years of 384,000,000 gallons. Greater Boston, for which this supply is intended, has a population of 1,100,000, and some 28 cities and towns can be admitted to the benefits of this supply. To prepare for the acquisition of the latest extension to these works—the Nashua reservoir—6½ miles of railway had to be taken up, 360 houses, including six school houses and four churches, removed, with inhabitants numbering 1,711. The surface soil for this reservoir was stripped at a cost of $3,000,000, including the draining out of some swamps, and the new water basin formed will contain 63 billions of gallons, having a water surface area of 4,195 acres. In building the dykes for these reservoirs the ordinary surface soil was largely and successfully used as puddling material in combination with masonry dams. One feature about these reservoirs is that no attempt has been made to construct square or circular basins, but the conformation of the land is left as if nature, and not the hand of man, had planned the whole scheme. The effect is very picturesque, and this chain of lakes will soon be one of the most charming sights for the people of Boston. After Mr. Stearns' lecture the visitors were taken to the rooms of the Boston society, where they were regaled by ice cream, light refreshment and drinks, and were shown the society's valuable library.

On Friday morning the party were taken under the guidance of Alexis H. French and W. Warren Cummings, to the works of the New England Gas and Coke Co. at Everett, a suburb on the Mystic river. The superintendent, Louis J. Hirt, accompanied the party and explained very clearly the process of manufacture. As this is dealt with in an interesting article in another part of this issue by Charles Baillairge, one of the Canadian visitors, we need only add that all were pleased with the visit and enjoyed the luncheon prepared for them by the company at the close of the inspection of the works. After luncheon Mr. Heckman called the party to the front steps of the office, and took the photograph reproduced in the accompanying engraving.

31¼ and 48 inches; diameter of pump plungers, 37 inches; stroke of pistons and plungers, 60 inches; revolutions per minute, 30; horse-power, 4co; contract price, $45,500 each, exclusive of foundations. Steam will be furnished by three vertical fire tube boilers. Each boiler will be 8 feet in diameter, 25 feet high and will contain 378 2-inch tubes. Thickness of shell, 25-32 of an inch. Heating surface 2,146 square feet.

The next point visited was the Natatorium, at Brookline, which is considered one of the best examples of municipal bath houses in the United States. Messrs French, Bryant, Forbes and Fletcher showed the visitors through this admirable institution, which we hope to be able to describe somewhat in detail in another number. The evening was devoted to the annual dinner, of which a report was given in last issue.

On Saturday morning the first event on the programme was a visit to the State Board of Health experimental station and filtering plant at Lawrence, but owing to the early hour at which the train started only one member was on hand. He had a car to himself on the journey, and was honored by a deputation and several cabs on arrival at Lawrence station. We hope to be able to give an account of his trip in next issue.

The members who remained in the city paid a visit to the Boston library, of which every citizen is justly proud. This great institution has its own steam and electric lighting and power plant, its own bindery and printing office, from which its catalogues, bulletins and special lists of books are issued. This library grew out of a gift of $100,000 made about 50 years ago by Joshua Bates, an Englishman, of London, who had lived some years in Boston; now the institution has in its main building 530,000 volumes, and the ten branch libraries have a total of 170,000 volumes besides, while 17 other stations are used to facilitate the distribution of books to the citizens.

During this day parties of the visitors made excursions on their own account, which included visits to the Boston Electric Light Co.'s central power house at South Boston, the Boston Elevated Railway Co.'s power house in Albany street; the freigfit sheds of the Boston-Maine system, Brockton Sewage Works, etc.

One of the most interesting and enjoyable of the many excursions was that to Harvard University, where President

Canadian Society of Civil Engineers.
From a Photo by I. W. Heckman, C.E., taken at the office of the New England Gas and Coke Co., at Everett, Boston.

In the afternoon the visitors were taken to the Chestnut Hill reservoir and new pumping station, where Charles W Sherman and W. J Sando acted as guides. There are four engines, representing different types and designs, the latest of which is a slow running engine of large capacity, designed to pump 30,000,000 gallons per day A new low service station is now being completed and will contain three vertical engines of 35,000,000 gallons capacity per day each The dimensions of these pumps are as follows: Diameters of steam cylinders, 17.

Eliot and several of the professors accompanied the Canadians around these historic buildings. They were shown how the students lived, and were treated to one of the every day students' lunches in the classical Memorial Hall. After lunch President Eliot gave the visitors an interesting sketch of the history of Harvard, and then showed them the remarkable collection of glass flowers—unique of its kind—of which we should like to speak at another time. Very instructive, too, was the visit to the observatory where Profs. Pickering and Bailey, so well

known in the astronomical world, showed the visitors some of the 10,000 photographic negatives of the heavens, which are stored up as books of the stars.

To the several professors of Harvard and the Massachusetts Institute of Technology, and to Leonard Metcalf, secretary of the Excursion Committee; to S. E. Tinkham, secretary of the Boston Society, and to Howard T. Barnes, Edmund S. Davis, H. Bissell (chief engineer of the Boston and Maine), H. A. Carson, of the Boston Transit Commission, and many others the visiting members of the Canadian society are under a heavy debt of gratitude for the trouble and time they took in showing them the engineering sights of Boston, and the visit will long remain one of their most pleasing memories. On returning to Montreal hearty votes of thanks were passed to the Grand Trunk and the other railways to whose kindness they were indebted for the transportation to Boston and return. The details of the trip were as usual admirably managed by the secretary, Prof. C. H. McLeod, who never spared himself when the comfort of the members was in question. The society is indebted to Mr. McNab, of the engineering department of the G.T.R., for the suggestion of this trip, which proved to be the most instructive as well as the pleasantest of all the society's excursions.

Regular Meeting, March 15th.

At the meeting of the Canadian Society of Civil Engineers, held on March 15th, the lecture on the Transmission of Electrical Power, by Prof. Owens, announced for the evening, was not delivered, owing to the absence of the lecturer, who was unavoidably detained in Quebec. In place of the lecture a short paper by Mr. H. J. W. Finch, Stud. Can. Soc. C.E., on the Canadian Pacific Railway Transfer Slip, Vancouver Harbor, British Columbia, was read. This slip is one used in connection with the transfer of coal from Vancouver Island to the mainland, and is situated near the C.P.R. wharf at Vancouver. The cars, twelve at a time, are carried on barges. The transfer slip is a pile structure. Connection is made between the fixed flooring of the slip and the barge by means of a counterbalanced apron, 33 feet long by 30 feet wide.

CANADIAN MINING INSTITUTE.

The annual general meeting of the Canadian Mining Institute was held at the Windsor Hotel, Montreal, on the 7th, 8th and 9th of March, the following members being in attendance: B. T. A. Bell, Ottawa; W. Johnstone, Crow's Nest Coal Co., Fernie, B.C.; R. Jeffrey, Toronto; C. Fergie, Intercolonial Coal Co., Westville, N.S.; Geo. McDougall, Montreal; A. H. Stevenson, Montreal; J. Stevenson Brown, Montreal; R. Meredith, Montreal; H. W. de Courtenay, Montreal; Geo. E. Drummond, Montreal; Eugene Coste, Toronto; J. W. Evans, Sudbury; A. C. M. Hay, Rat Portage; C. Morgan, Toronto; H. Wylde, Halifax; N. M. Campbell, Montreal; David G. Kerr, Marmora, Ont.; P. Kirkgeear, Deloro, Ont.; Prof. W. G. Millar, School of Mining, Kingston, Ont.; Dr. W. L. Goodwin, director School of Mining, Kingston; W. Blakemore, Montreal; Archibald Blue, director Bureau of Mines, Toronto; A. Boas, Montreal; R. S. Hopper, Montreal; R. Blackburn, Ottawa; Major-General Sir Henry C. Wilkinson, Regina, N.W.T., and London, Eng.; S. Simpson; Dr. J. B. Porter, F. W. Maclennan, W. H. Ogilvie, S. F. Kirkpatrick and A. R. Archer, McGill University, Montreal; T. Denis, A. P. Low and A. E. Barlow, Geological Survey, Ottawa; Dr. Frank W. Adams, McGill University, Montreal; R. W. Brock, Geological Survey, Ottawa; Prof. A. Courtenay De Kalb, Kingston; C. C. Hanson, Montreal; J. B. Smith, Montreal; J. B. Tyrell, Dawson City; J. Obalski, Quebec; A. W. Fraser, Ottawa; Chas. Brent, Rat Portage; J. F. Higginson, Buckingham, Que.; J. D. Craig, Kingston; S. N. Scott, Kingston; J. D. Maclennan, Kingston; E. L. Fralick, Kingston; F. G. Stevens, Kingston; F. Gilbert, Kingston; F. H. Hopkins, Kingston; Thomas Bacon, Kingston; S. S. Fowler, London and British Columbia Gold Fields, Nelson; Major R. G. Leckie, Sudbury; John Blue, Eustis Mining Co., Capelton, Que.; Jas. Reed, Reedsdale, Que.; F. T. Peacock, Montreal; D. Brainerd, Montreal; R. G. McConnell, Geological Survey, Ottawa; F. Cirkel, Ottawa, and J. M. Clark, Toronto.

Wednesday morning.—In the absence of the president, John E. Hardman, the chair was taken by Geo. E. Drummond, who, in a short opening address, stated that since last year many things had happened of great interest to the mining community; and that, though two or three occurrences had taken place in the mining world which were liable to discredit Canada in the eyes of investors, yet, as a whole, the mineral development of the country had been satisfactory.

Secretary Bell moved that the minutes of last year's meeting be accepted as read, they having been printed and in the members' hands already. He gave the names of twenty-three gentlemen who were proposed as new members of the institute. These were unanimously elected. The financial statement, he said, showed up very well, and proved that the growth of the Institute, both in numbers and in influence, was highly satisfactory. Several members of the Institute, he said, were now helping the cause of Great Britain in South Africa; and the previous day he had received from Thos. Brown, a letter, dated Cape Verde Islands, regretting his inability to read a paper before the Institute this year, but expressing the hope of being able to do so for the next meeting, on the subject of "The Effects of Lyddite." Since last meeting, five members of the Institute had died, viz., J. McGregor, W. G. Nelson, Morris Buck, J. T. Tuck and A. H. Budden. The papers read at the previous year's meeting had been published and met with a cordial reception, having been republished in several American and European technical journals. He stated that he had had several interviews with the Minister of Customs, and had succeeded in obtaining an Order-in-Council placing gold dredging appliances on the free list. The Quebec Legislature also had passed an Act exempting mining property from municipal taxation for a further period of ten years. He then gave a brief resumé of the mineral development of Canada during the past year. It was very hard to give a just idea of the output, owing to the fact that the Provincial and Dominion Governments all had different standards, and their fiscal years ended at different periods. It would be a good idea to suggest that there should be some uniformity in these matters. Every mining man would agree with the statement that in Nova Scotia the returns of mining matters were arranged in a disgraceful manner. Fifteen million dollars, he thought, would be a conservative estimate of the amount of gold produced in the Yukon last year. In British Columbia, according to W. F. Robertson, the metallurgist, there had been a very material advance, though on certain lines, no doubt, it had been unsatisfactory. On the whole, however, there had been healthy, legitimate progress. Ontario's minerals showed an increase of 17 per cent. over previous year. The nickel industry showed signs of rapid progress, and will probably before long become a great one. Of Quebec, about the same might be said, and mica was showing up well. Electro-metallurgy, was responsible for considerable progress at Buckingham, as it was by that process that phosphorus was being obtained direct from the apatite, with ferro-manganese for a by-product. Mica had been found to be the best substance for annealing steel, also for boiler coverings. In Nova Scotia, the conditions were encouraging, and the coal output had largely increased, owing to the finding of larger markets. The Dominion Coal Co. at Sydney would make a great showing after a while. In gold there had been a slight falling-off. Many of the mines had been bonded and were being he'd by the owners without working. The following would be a rough but conservative estimate of the net value of the Dominion's mineral production for the past year: Northwest, $18,000,000; British Columbia, $11,000,000 to $12,000,000; Ontario, $8,500,000; Quebec, $3,000,000; Nova Scotia, $8,000,000; or, roughly, a total of about $48,000,000.

Dr. Goodwin, in seconding the adoption of the secretary's report, said it showed many encouraging signs. Not only did old industries hold their own, but several minor industries were beginning to come into play.

It was resolved that the Institute should, as a body, contribute $250 towards the Canadian Patriotic Fund, and that in addition a subscription should be opened at the meeting to receive individual subscriptions. In moving this resolution, the secretary announced that $100 had been already received from the Canadian Copper Co., and $100 from the Acadia Coal Co., for patriotic purposes.

W. Blakemore remarked, in connection with this subject, that no body of men were more dependent upon the protection of the British flag than mining men, and it was fitting that they

should show their feeling in this matter. Archibald Blue said that not only had the Canadian boys in South Africa shed an honorable lustre over the whole Dominion, but that the war would help this country in a material way as well. In future, not merely would the money requisite for the development of Canada be more easily obtainable, but interest in us had been so quickened that emigration would look this way also. One of the lessons of the present war to the people of Great Britain would be the value of sending their men to the colonies. Had a larger proportion of the families who had left the Mother Country to settle in the United States and foreign countries gone instead to South Africa, Canada and Australia, there would probably be no South African question to disturb the world's peace to-day. The British connection was a great thing for the Dominion, and more especially for mining men, whose duties often took them to undeveloped countries. It was unanimously resolved to remit the dues of those members who were upholding the honor of the flag in South Africa.

Secretary Bell said that the Institute was now in a position to say who should, and who should not be members. He had no wish to make it a close corporation; but he certainly thought it ought to be a purely technical or business society, so that when a man should be able to say he was a member of the Canadian Mining Institute, it would mean something, and prove that he had the right, by experience and education, to really call himself a mining engineer. He thought that members of the Institute should be persons engaged in the direction and operation of collieries, metal mines, blast furnaces and metallurgical works, mining, mechanical, electrical or civil engineers; geologists, metallurgists or chemists; and such other persons who from their connection with the profession of mining the council might see fit to elect. And that Associate members should be persons not eligible in the foregoing, but such as the council should deem worthy of admission; and that they should enjoy full privileges of membership. This brought up the question of "amendments to by-laws and constitution," and a committee was appointed to enquire into and decide upon the matter.

Wednesday Afternoon.—A. P. Low read a paper on the Iron Ores of Hudson's Bay, in which he told the history of his explorations in that district. The first mention of Labrador ores had been made by Dr. G. R. Bell in 1877. With every extensive exploration, he said, large new areas of valuable iron ores had been discovered, and with further efforts no doubt other areas would be found, some of which might prove sufficiently accessible to become of great commercial value. At present, the lack of railroad facilities rendered the ores of Ungava Bay and the interior useless. The coast deposits could perhaps be shipped down on lighters, but the season for navigation was probably not more than three months and a half. Another question was that of fuel. No coal had been found in that country. There was a large mass of driftwood on the islands near the coast of the bay, but he did not know whether this would answer for smelting purposes; and wood for making charcoal would need to be transported a great distance. There was plenty of water power for electric smelting. The chances were, however, that these deposits would remain one of the undeveloped resources of the country for a long period.

Archibald Blue said he had been on Lake Temiscuing, and found that there was a streak of jasper running across under it, with iron in close connection. On Lake Boya a very interesting discovery had been made, the diamond drill having shown that hematite extended below the bed of the lake for 188 feet, which would represent an enormous amount—some 12,000,000 tons. Deposits of lead hematite had been found to extend several miles from there. There was a probability that the jasper region extended all the way from Lake Superior to Lake Temiscuing, and this region ought certainly to be explored. He would like to know more about the transportation question, in connection with the ore areas of which Mr. Low had spoken.

A. P. Low replied that if a railway were run from Ottawa, in continuation from the Gatineau Valley Railway, the haulage of the ore would be about 400 or 500 miles by railroad from the southern end of James' Bay, to which the ore could be brought down on lighters during the summer.

Secretary Bell asked what sort of navigation was there on the bay? Mr. Low replied that there was deep water right up to the shore. Hudson Bay was open to ordinary navigation from the middle of June up to November, but Hudson Strait would not be open probably before the middle of July.

The next paper read was one by R. E. Chambers, of New Glasgow, N.S., on the Iron Deposits of Bell Island, Conception Bay, Newfoundland, in which the writer stated his opinion that perhaps one could hardly adjudge at their true value the Newfoundland deposits. For high grade quality and economical working they were remarkable.

Chas. Fergie, Westville, N.S., then gave some results in the use of a rotary pump as against that of the straight line type.

Arch. Blue read a paper entitled, Are there Diamonds in Ontario? Briefly touching on the manner in which it had gradually dawned upon Canadians that Ontario was a great mineral country, the writer stated that nickel, copper, gold, iron, graphite and mica might be said to occur abundantly. One highly important mineral, it was true, Ontario did not possess to any extent, and that was coal; was it impossible, however, that fuller exploration would eventually prove that Ontario possessed carbon in its purest or gem form, viz., the diamond? Corundum was there in quantity; and where this existed, there was always a hope that sapphires and rubies existed also. Small sized diamonds had been found in the States of Wisconsin, Ohio and Michigan, and these had been imbedded in the glacial drift. Now the materials of this drift had come down during the Ice Age; and in Ontario, many stones and gravels had been discovered identical in composition and structure with those in the drift in which these diamonds had been found imbedded. From the geological formation of the Keewatin district, he thought that it was there that diamonds should be looked for, and with considerable prospect of the search being rewarded with success.

Dr. Goodwin brought to the attention of the Institute the fact that recently some materials had been discovered of greater hardness even than diamonds. Mr. Barlow stated that Dr. Lawson had remarked, several years ago, that he had but little doubt that diamonds would eventually be found in the districts north of Lake Superior. A. P. Low remarked that the diamonds referred to in Mr. Blue's paper were supposed by some to come from the Hudson's Bay region, though he was at a loss to know from what part. They might possibly occur on the islands near the east coast, where there were Cambrian or Huronian rocks, capped with a considerable thickness of black shales, on the top of which there were several hundred feet of trappe. In St. James' Bay was a mass of gneiss rock, composed largely of garnet, with hornblende also in the composition; and this somewhat resembled the sort of rock found at Kimberley, where the diamonds came from. Eugene Coste said that probably the diamond was a constituent of the plutonic rocks, just as magnetite was; and he did not think that in looking for diamonds it was necessary to confine one's attention to carbonaceous shales. A much better place to search was where the plutonic rocks were driven upwards, and denuded, and showed their inner parts, like the neck of the Kimberley mines.

Wednesday Evening.—The proceedings opened with a short paper by C. E. Morgan on Mining Pumps. C. Fergie remarked that there was not a single pump in the market really made to work with compressed air, though in 50 or 75 per cent. of the mines air was the motive power used. R. W. Brock, of Ottawa, read a paper on West Kootenay Ore Bodies. J. Burley Smith, referring to the writer's mention of the limitations of prospectors, said that the duty of a prospector generally was to look for surface indications; the work of tracing the vein was properly the duty of the mining engineer. A. W. Stevenson said he had no particular wish to criticize, but judging from the manner in which some mining properties were being developed, it would be just as well to take the whole mountain, and, starting from the top and going downwards, to mill the whole thing. And perhaps it would not prove so much more expensive than the operations in current use, either. W. Blakemore referred to the vast amounts expended in developing properties which were absolutely worthless, the idea being perhaps to show a little work, and then sell out at a profit. In many cases it would have cost no more money to really develop the properties in question, than had been already used merely in putting them in shape for selling. If it had been spent in an honest attempt to do the best possible for the property, the money would not have been wasted, and at the same time there would be much more encouragement for investors of capital in this country.

W. G. Millar, of Kingston, gave an address on Corundum, which, said he, existed throughout a large area in Ontario, the quality of which could not be excelled. The uses of this mineral

were constantly being extended. Some forms of metal, it had been found, were not readily acted on by emery alone, and now manufacturers were beginning to mix corundum with their emery, in order to improve the latter's abrasive qualities. It had also been found to be better than emery for sharpening circular saws, as it did not spoil their temper. Perhaps also other uses would be found for it in pulp mills. It had been at first thought that its place would be taken by carborundum; but experience had shown that the latter in some respects was by no means equal. It had been stated by some that in North Carolina there were such enormous quantities of corundum that the prices would be reduced; but on going down to that state and investigating, he had found that the quality was inferior. The corundum of Ontario could be extracted from the rock easily; in North Carolina, however, much of it had to be treated with acid, which was a very costly process.

Archibald Blue stated that a company had been formed to develop the corundum industry in Renfrew and Hastings counties, at first with a capital of $250,000, which afterwards they had decided to increase to $1,500,000. Steps were now being taken to put up a big plant, and it was expected to place the article soon on the market. Much correspondence had been received from Great Britain, United States and Europe, so it looked as though there would be a large market awaiting it, so soon as it could be produced in quantities. One other possible use for corundum not mentioned, he said, by Mr. Millar, was as an alloy for aluminum. He did not know whether any satisfactory process had yet been discovered to this end; but he felt sanguine that some persevering man would ere long succeed in finding a way to use it in the production of aluminum. Should this be done, it would add immensely to the value of the ore in this country. Prof. Dick Callum remarked that the only difficulty in the way of this consisted in making it sufficiently fine to combine. Dr. Adams said the rock is which corundum occurs varied greatly in color—from light to dark. In the places where it occurred at all, it was usually very abundant, and he had no doubt but that it would prove a highly profitable industry, provided the prices keep up satisfactorily.

Thursday Afternoon.—The next session of the Institute took place on Thursday afternoon, many members having expressed the wish to seize the opportunity of being in Montreal to attend to private business in the morning.

J. M. Clark read a paper on the Mining Laws of Ontario in which he gave a short history of the mining laws of that province and a synopsis of their present condition. It was very desirable, he thought, that the whole question of company law should be simplified and put into a more satisfactory condition. It was a matter for congratulation that the mining laws in Ontario were largely statutory, the power to interfere with mining matters except by special parliamentary legislation being very restricted. Eugene Coste said, no doubt the mining laws of Ontario were by no means perfect, but, on the whole, they were fairly satisfactory. It was a matter for congratulation that in that province there was an attempt at having a system of mining laws, not very subject to Orders-in-Council. In this respect it was a great contrast to the way in which the Yukon country had been governed from Ottawa. In the Yukon, it could not be said that there was any mining law; it was governed by mining regulations, made in the Department of the Interior, signed by the Minister, and changed every day or every week or so. The variability of these regulations had been the curse of that country, and Mr. Fawcett, the gold commissioner, had acknowledged he did not understand them himself.

Mr. Fraser said that in mining as in all other legislation so far as his experience went, the all-important point was that it should be clear and definite, and of as permanent a character as possible, without changes from year to year, if they could possibly be avoided. Many of the men engaged in mining operations—prospectors and others away out in distant regions—were not familiar with the changes that were taking place; they had neither the time nor the opportunity to study these changes, and for these reasons the legislation should be as definite and permanent as possible. He was glad to bear testimony to the just character of the Ontario mining laws. They were a credit to the province, and showed an evident desire on the part of its legislators to meet any difficulties that might arise regarding its mining interests.

J. C. Gwillim, of Ottawa, contributed some Notes on the Atlin Gold Fields. The Atlin region, like some other gold fields, he thought, had been over-rated, the placer district being confined to seven or eight creeks in a region about ten miles by twenty. Last spring, the population had reached perhaps 5,000, but now it could hardly exceed 1,500, many people having moved to Cape Nome and other fields. This country was more easily accessible, and the climate more favorable than in the region further north. Labor fetched about $5 per day, and provisions were about twice as expensive as in the outside world. The great drawback was the British Columbia system of mining laws, which limited the claims to a length of 100 feet, thus not giving room to deposit the debris and continue working. Many claims had been deserted when only half worked out. No doubt the future would show what could be done by hydraulic mining on a large scale.

Eugene Coste said the mining laws were a disgrace to the province, and went on to give some instances of the manner in which the British Columbia Government, in its desire to keep out aliens and foreign companies had really legislated against the development of the country even by Canadians.

Eugene Coste followed with a paper on the Natural Gas Fields of Ontario, in which, after giving a minute account of the operations of boring in several gas wells in that province, with an account of the various strata through which the drill passed in each instance, he went on to explain his theory of the formation of natural gas. He claimed that the gas-producing strata were not of organic origin, but the result of volcanic activity in past ages. Dr. Goodwin wondered whether there was any evidence of the formation of hydrocarbons in any stratum where organic origin was clearly altogether out of the question. Several facts, he thought, pointed to the chemical theory of the origin of hydrocarbons.

The report of the committee appointed to look into the proposed amendments to the by-laws and constitution was presented, from which it appeared that they had come to the conclusion that the whole subject was very much larger than had been anticipated. It was resolved to leave the matter over until the next annual meeting, and a committee, consisting of Archibald Blue, Dr. Goodwin, S. S. Fowler, Mr. Hay, J. Burley Smith, W. Blakemore, Mr. Hopper, Mr. Fraser and B. T. A. Bell, were appointed to thoroughly investigate the matter and report at that time.

It was ordered that the papers should be printed in the annual report. A notice of motion was presented to provide for the establishment of a reference library and headquarters for the Institute in some central locality (probably Ottawa), as provided for in the constitution.

Thursday Evening.—Dr. Porter, of McGill College, gave a very interesting lecture illustrated by views of mining operations, exterior and interior, in Canada, United States and Great Britain. A. P. Low also presented some fine views, taken while on his expedition to the Hudson's Bay country, showing forth the habits of the native Indians and Esquimaux.

R. G. McConnell, of Ottawa, read a paper on the Gravel Benches of the Klondike, which provoked a lengthy discussion. Eugene Coste stated that when he was in that country last September, the Government had not spent a cent in making roads from Dawson City to the Klondike. The cost of transporting goods was enormous—about one cent per pound per mile. It was a shameful thing, that the Government, which charged a royalty of 10 per cent. on the gross output of the mines of the Klondike should not have built one mile, or one inch, of road. To the men who went up in that frozen north country, it was cruelty; and Mr. Sifton and the Ottawa Government, he thought, ought to be brought before all the Cruelty Prevention Societies in the country for the way in which, for four years and more, they had allowed this to go on, and that after making money out of the country. For in a speech in Manitoba recently Mr. Sifton boasted that he had made the Yukon pay for itself, and had made $670,000 profit besides. In answer to a question from the chairman, he stated that there ought to be no great difficulty in building roads. The chief difficulty was to put the Government into a frame of mind to get started in earnest. Secretary Bell said that so long as a 10 per cent. royalty should be exacted by the Government British capitalists would refuse to invest money. For all practical purposes the Klondike was a dead issue. Mr. Ogilive, he went on to say, had stated that there was $50,000,000 in sight in the

Klondike. Now, Mr. Ogilvie was a good man in his own line, but no competent mining engineer would ever commit himself to such a statement as that. The cost of getting into the country was enormous. More money had been taken into the Klondike than had ever been taken out of it. J. B. Tyrrell agreed that the 10 per cent. royalty was too onerous, and a very serious drawback in the eyes of capitalists, who believed that the margin might be close. Besides the royalty, there were so many other percentages—the banks charged 3 per cent. for assay and 2 per cent for export drafts. Each man, also, had to pay for a miner's license, all of which was a handicap to the country. Then, again, the probability was that only honest men paid the royalty, the rogues finding a way out of it, thus creating a premium on dishonesty. The exemption of the first $5,000 only made it easier to do this. He trusted that the Government would take the matter up thoroughly, and put it on an altogether different and more satisfactory basis. According to reports of the United States Mint, the output of the Yukon during the past year was about $16,000,000, though royalty had only been paid upon $9,000,000 to the Canadian Government. A better system would be for the Government to establish an assaying office and buy the gold outright on the spot, giving certificates for the same, redeemable in cash when the owner should reach the outside world. If the Government charged, say, 3 per cent. upon the assay, all expenses would be more than met—and it was not desirable to make a large profit, so long as the country should be self-sustaining. Such a system would mean that all the gold produced would be recorded. At present, claims on the product of which the royalty had not been paid, were liable to forfeiture. This was a defect which would be removed if a record were kept of the entire output. This could easily be done, as all gold going out of the country had to go either up or down the river, and gold was too heavy to be carried on the person. With regard to the prospects of placer mining in the Yukon, he believed it would last for twenty years yet. Many times the amount which had been taken out remains yet to be found. He was speaking of known properties only—but in addition to those, there was a large section of country which had not been touched. At the same time, he would not advise anyone to go out with the idea of prospecting for individual claims. It was necessary to have capital; and those who invested judiciously would make money. The conditions in Dawson City were improving, and life and property were as safe there as anywhere, and it was now possible to obtain fresh meat, vegetables, milk, etc., so that living was tolerable.

It was resolved to prepare a petition to the Government praying that the royalty on gold extracted in the Yukon district should be reduced from 10 to 2 per cent. Friday morning was occupied in formulating the result of the election of office-bearers.

Friday Afternoon.—The scrutineers reported the result of the election of officers of the Institute as follows: President, S. S. Fowler, Nelson, B.C.; vice-presidents, C. Fergie, Westville, N.S., and Jas. McArthur, Sudbury, Ont.; secretary, B. T. A. Bell, Ottawa; treasurer, J. Stevenson Brown, Montreal; Council, for British Columbia, E. B. Kirby and Bernard Macdonald; for Ontario, Major Leckie and R. G. McConnell; for Quebec, Jas. F. Lewis and J. Burley Smith, and for Nova Scotia, G. F. McNaughton and H. S. Poole.

The point was brought up as to whether newly elected members, whose subscriptions had not been paid, should be empowered to vote or not. It was resolved to refer this question to the committee for Amendment to By-laws and Constitution.

The new president, on taking the chair, gave a short address thanking the Institute for the honor which had been conferred on him, and briefly referring to the condition of British Columbia's mining industry. While, of course, he said, the output from British Columbia was not so large as from some States to the south of them, yet it was very satisfactory, and was increasing all the time.

Arrangements for holding the summer meeting (probably at Sydney, C.B.), in connection with the American Mining Engineers were left to the council to decide. On the motion of B. T. A. Bell, seconded by J. Stevenson Brown, a vote of thanks was accorded to the retiring officers.

Major R. G. Leckie, of Sudbury, then read some Notes on the Nickel Question, which provoked an animated discussion. Canada, he said, had a good opportunity to maintain her hold on the world's nickel market, providing the industry were properly encouraged, instead of being suppressed by hostile legislation. J. M. Clark referred to the system of export duties, against which all political economists, he said, were loud in condemnation. He was utterly opposed to any such system as that proposed by the Ontario Legislature in a recent Order-in-Council, placing an export duty on nickel and copper ore exported from Canada without being first refined. Mr. Holland emphasized the remarks of the previous speaker in his condemnation of the course of the Ontario Government. That the nickel and copper interests should be vested in the Crown, and that an export duty should be placed on the ore was a most ridiculous proposition. No such legislation had ever been heard of in a British colony. If the desire of the Ontario Government had been to cripple the nickel industry of the country, they could not have devised a better scheme. He then read a series of letters from Dr. Monn, the inventor of a new process for extracting and separating nickel and copper from the ore, and who was prepared to establish large works in Ontario, providing he was not discouraged by hostile legislation. The letters went to show that it would be impossible for him to carry out his scheme, with the possibility existing of any such Order-in-Council being passed. Secretary Bell said he sympathized with Mr. Archibald Blue, a Government official, in his presence during the passing of so many strictures on his own Government; but he thought it was certainly a fair subject for discussion. It would be a serious matter if Orders-in-Council were to be passed crippling the production of asbestos, mica, and other minerals in Canada; yet, the same reasons which had been urged in favor of the Order-in-Council respecting nickel, might be urged—and just as wrongfully—against those products also. The old argument that we had a monopoly of these minerals in Canada was fallacious. It was a fact that most of the persons who had argued in favor of this new Ontario legislation were not Canadians at all, and had no interest in the Ontario nickel industry. The Canadian Copper Co., though an American corporation, was a credit to the country, and it was sad to think that just as soon as their project was becoming profitable they should be crippled in this manner. It was not right to treat American and foreign investors shabbily; and it was right that they should be allowed to make money here; this was our only argument to induce them to come to Canada again.

Archibald Blue said he could not help feeling that there was some misunderstanding among members of the institute respecting the objects of the Order-in-Council, which had been so warmly discussed. It was certainly not the purpose of the Ontario Legislature to do anything to cripple any industry in the province. Secretary Bell moved a resolution to the effect that the Order-in-Council passed Nov. 23rd, 1899, by the Ontario Government prohibiting the export of copper and nickel, except in the condition of refined nickel and copper, would prove fatal to the industry; that the imposition of an export duty on nickel matte by the Dominion Government would make it impossible for the Canadian producer to compete with foreign countries; and that a copy of this resolution should be forwarded to the Premier, the Commissioner of Crown Lands for the province of Ontario, the Minister of Finance and the Minister of Trade and Commerce, together with a reprint of the discussion which had taken place. This motion was seconded by Mr. Holland, but was subsequently withdrawn on the understanding that the matter should be fully threshed out by the council, and dealt with as that body might see fit. The other papers on the Syllabus were taken as read.

The proceedings terminated in the evening with a very enjoyable smoking concert, the music being delightfully rendered by members of the Zingari Club, Montreal.

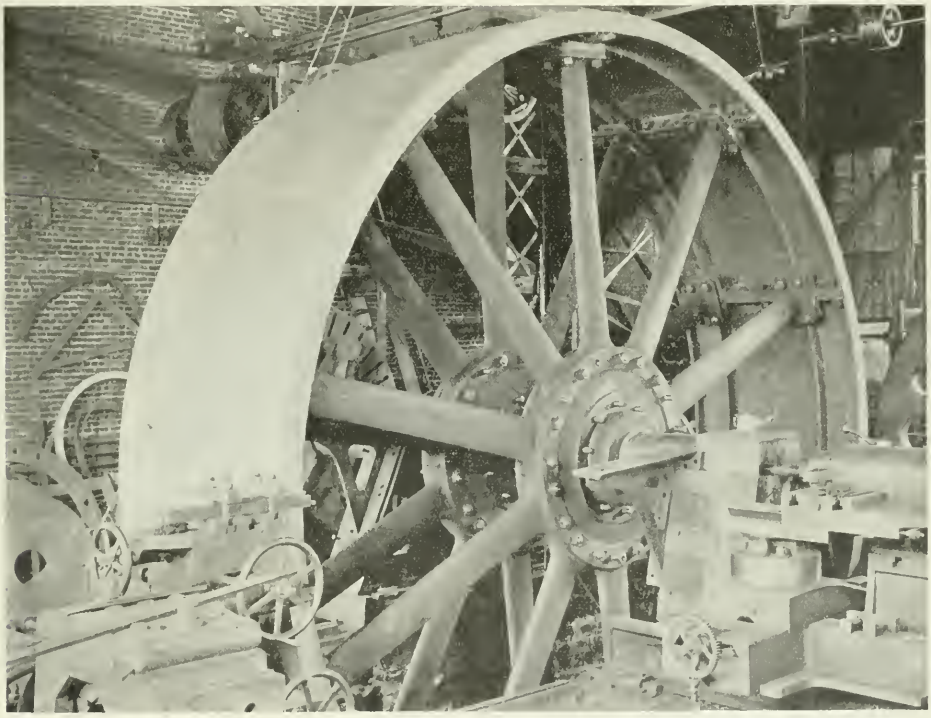
—Every good oil paint and red lead coating will protect the water reservoir from rust, and when it is perfectly dry will not give the water any noticeable side taste. The only drawback is that the oil coating does not last long. For this reason a cement coating is considered superior to oil paint. Cement dries perfectly in a few hours, and if it is made right lasts at least as long as oil paint, while its cost is next to nothing. In the Experimental Brewery at Berlin (says the Nordd Bangew Anzeiger), the lime and warm water receptacles are painted with cement, and after four years' use, the coating has not required renewal.

LARGE COMPOUND ENGINE.

The Laurie Engine Company, of Montreal, has just shipped the Ogilvie Milling Company, of Winnipeg, one of its 1,000 h.p. Corliss tandem compound condensing engines, the general dimensions of which are as follows, viz.: High pressure cylinder, 24-in. in diameter; low pressure, 48-in. in diameter, with a stroke of 48-in. The main shaft is 18-in. in diameter, the journal being 16 inches diameter and 32 inches long. The general design is what is known as the heavy duty type. The frame casting which carries the main bearing weighs 12 tons. The fly wheel pulley is 22 feet in diameter and 6 feet 2 inches across the face, the rim of which is made in ten sections with two sets of arms (ten in each set), with four heavy flanges forming the two hubs. The wheel weighs about sixty tons.

The Laurie Engine Company's method of constructing these large wheels is different to the general practice in that the parts are never assembled until the wheel is put into the lathe for turning. The sections are machined on all four angles (and completed ready for going together) on a special milling machine designed for the purpose. The arms and flanges are faced, turned and drilled to jigs, making all the parts perfectly interchangeable, so that when the wheel is put together in the lathe it is simply a matter of bolting the parts together, there being no fitting to do whatever. The securing together of this particular wheel required 240 low-moor iron bolts, each 2¼ inches in diameter. This wheel is illustrated herewith. The steam cylinders are both steam jacketed, and fitted with the company's improved double eccentric valve motion. The receiver between the cylinders is furnished with superheating tubes of seamless drawn brass.

The condenser plant is of the surface type, the condenser being of the rectangular type with 2,000 feet of cooling surface. The pumps (air and circulating) are of the vertical, crank and fly-wheel type, driven by a 14-inch Corliss cylinder. The whole engine is designed with a view to obtaining the highest possible economy. It is built extra heavy throughout (weighing about 350,000 lbs.) and reflects great credit on the builders.



FLY WHEEL OF LAURIE ENGINE CO.'S NEW ENGINE BUILT FOR OGILVIE MILLING CO.

BLUE PROCESS PAPER.

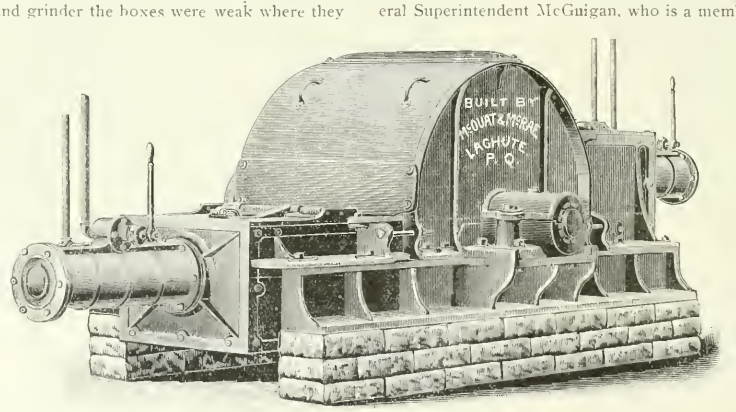
The prepared paper for this process is of a light greenish yellow tint when freshly coated. In the course of time, however, and particularly during the summer months, the paper turns to a darker tint up to a blue gray, which, however, is no indication that the paper is spoiled and unfit for use. Good prepared paper for this process will keep unimpaired at least three months. The Helios papers have been for many years generally recognized as the best for photographic and other fine work, states the Keuffel & Esser Co., in Photo-Printing from Tracings, a pamphlet recently issued. Both their printing and keeping qualities are superior to other blue print papers. Where price is more of an object than quality, the Columbia papers are generally preferred, as being the best value for the money. Cheaper papers can be bought, but they are not economical. The difference in price is small and not enough to compensate for inferior results, to say nothing of the waste of time and paper through the tearing of wet prints. When extra toughness is wanted, the Parchmine papers are used, unless light weight is also a consideration; in that case the E.T. (extra thin) papers are recommended.

Blue process papers cannot be judged by their color; only an actual test will show whether the paper is perfect or not. The exposure of blue process paper takes from four to eight minutes in bright sunlight, varying, of course, with the intensity of the light and the transparency of the material upon which the tracing is made. In the shade, or on dark and foggy days, the exposure may last up to one hour before it is completed, and on such days judgment must be used in determining its duration, and good care taken that the paper is not taken from the frame before it has been sufficiently exposed. When the margin protruding from under the original drawing has attained a greenish-bronze color, open one part of the back of the frame and observe the copy. If the lines stand out sharp and distinct on a gray background, the exposure is completed. Then take the copy from the frame and place it in a bath tray containing sufficient water to fully cover the print. Here the lines will gradually turn into white while the background is changed into brilliant blue. Rinsing

the print by means of a spray will quicken the washing. As soon as the lines stand out in clear white the print may be taken from the bath and hung up to dry, which completes the work. Remember that the fresher the paper is the slower it will print and the quicker it will wash out; the older the paper is the quicker it will print but the slower it will wash. To obtain satisfactory results never take prints from the water bath before the lines are perfectly white, although it may take hours to effect this. As soon as the bath becomes discolored, renew by fresh water, as otherwise the chemicals dissolved in the water will discolor the white lines to a bluish hue. The longer the exposure the darker the blue ground of the paper will be, but the lines of the drawing should always appear in a clear white color, provided the original shows opaque lines. The copies after drying will be darker than when they are taken from the bath. Papers printed in direct bright sunlight will generally not produce such a rich and beautiful blue background as those which are exposed in the shade.

A NEW PULP GRINDER.

McOuat & McRae, engineers and founders, Lachute, Que., have placed on the market a wood pulp grinder, which is here illustrated, and which has been strongly commended by pulp manufacturers who have tested it. This is the New England type of grinder, but of an improved make, and while the price is as low as the New England grinder, the capacity is greater, the machine has a longer life, and will run with less power. In the ordinary New England grinder the boxes were weak where they were fastened to the machine, and often ripped off. By the system of flanges and bolts adopted by McOuat & McRae, the strength is greatest where the strain is most severe. The pockets also can be made fewer and of larger capacity, and are so placed that the pressure and friction are balanced on each side of the stone. By grinding on a large surface with comparatively low pressure, the resulting fibre is longer and better preserved. The result is not only a greater grinding capacity, but easier running with less power. The machine takes a stone of 26 inch face by 50-inches in diameter, held on the shaft by flanges screwed on by right and left thread. Each pocket will admit a piece of wood 24-inches long by about 16 inches in diameter, against a piece 18-inches long in the ordinary grinder. There is therefore less waste in splinters and small pieces at the finish, and there is less stopping to fill the pockets. The Lachute grinder can be built with two or three pockets. Where a third pocket is used the balance of pressure is preserved by using the third pocket while one of the other two is being refilled. The pressure cylinders are lined with brass, and the pistons packed the same as in the hydraulic press, so that while working freely they are also water tight. Samples of these grinders may be seen in the pulp mills of Hamelin & Ayers, Lachute, and Ford & Co., Portneuf, Que., both of which firms speak in the highest terms of the efficiency of the machine. McOuat & McRae also manufacture other pulp machinery such as stuff pumps, high pressure pumps, fire pumps, calendar roll grinders, etc., which are now gaining a good name in the Canadian mills.



The Lachute Pulp Grinder

AMERICAN ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.

This association, which was formed a little over a year ago, held its first annual convention in Chicago on the 14th and 15th of March, at which there was an attendance of nearly 150 members. Over one hundred railways, covering an aggregate length of more than 140,000 miles, are represented in this association, and the membership is composed of the principal engineers and general officers of these railways responsible for maintenance of way matters.

President J. F. Wallace, of the Illinois Central Railroad, occupied the chair, and made an excellent presiding officer. Mr. Wallace also has the distinguished honor of being president of the American Society of Civil Engineers, and to him, as well as to Mr. L. C. Fritch, the secretary of the new association, is largely due the success which has characterized all the proceedings of the organization since its inception. The preliminary reports of the several standing committees were read and discussed, and judging from the work of these committees so far, the schemes and objects of this association are most comprehensive, and its high aim, and the zeal of the officers in their efforts to promote these objects were well exemplified in the plan of work. There are fourteen standing committees, and the subject-matters respectively entrusted to their investigations embrace every feature connected with the construction, operation and maintenance of railways.

The Grand Trunk Railway system was represented by General Superintendent McGuigan, who is a member of the board of direction; assistant engineer W. McNab, vice-chairman of standing committee on graduation (who presented the report of that committee), and Superintendent W. Cotter, of the Western Division. The Canadian Pacific representatives were: Chief Engineer P. A. Peterson, first vice-president, and Superintendent James Oborne, of the Western Division.

The standing committees deal with the following subjects: Graduation, ballasting, ties, rail, track, buildings, bridges and trestles, masonry, signs, fences, crossings and cattle guards, signalling and interlocking plants, records, accounts and reports, uniform rules, organization, etc.; water service, yards and terminals. Each of these fourteen standing committees has five or ten subdivisions of work, so that if the programme of the association is carried out it will prove an organization of the highest importance to the railway interests of the continent.

CALCIUM CARBIDE AT CHICOUTIMI, QUE.

One of the most important of the many developments of electricity now going on in Canada is that for the production of calcium carbide on the Saguenay River, near Chicoutimi, Que. On February 5th of this year, Thos. L. Willson, the inventor of the process of producing calcium carbide now so much used, bought from the Quebec Government the Saguenay power at tide water, which is capable of a development of 60 feet head, and would give over 200,000 h.p. At this point the Ship Shaw River falls into the Saguenay, and has quite a flow of water,

giving at its minimum about 15,000 h.p. under a development of 138 feet over the water wheels, the total fall being over 150 feet.

Here Mr. Willson proposes first, to develop 10,000 electrical h.p. on the Ship-Shaw, and a second development of 100,000 h.p. on the Saguenay, leaving a further possible power development on the Saguenay of over 100,000 h.p. When the Saguenay power is developed, this will be an excellent location for wood pulp manufacture and paper mills, as it is the centre of the finest pulp wood districts in the world. There would be also power to spare for renting to other industries, and being on tide water, and having a railway running to the works, the location would afford a most advantageous situation for manufacturing industries. The development of 10,000 h.p. in the Ship-Shaw is now proceeding.

Industrial Notes.

Edmonton, N.W.T., will build a hospital at once.

The Brockville Peat & Power Co. will install a large drier.

Graham & Johnston have moved their file works from Almonte, Ont., to Toronto.

The Toronto Cold Storage Co. has increased its capital stock from $50,000 to $100,000.

The Winnipeg mill, of the Ogilvie Milling Co., is being enlarged to 3,000 barrels' capacity.

The Manitoba Cream Separator Co., headquarters, Winnipeg; capital, $75,000; is seeking incorporation.

Murney & Baechler, sawmill, Sarnia, Ont., will install a large engine, and are now looking about for one.

The Henderson Bicycle Company, Ltd., has changed its name to The Goderich Engine and Bicycle Company, Ltd.

Sydney, C.B., town council has voted $200,000 for sewerage, water system, fire department, sidewalks, and schools, etc.

R. H. Bogart, formerly with the Rathbun Co., Deseronto, is foreman for the Canadian Wood Specialty Co., Orillia, Ont.

The Northey Co., Ltd., has been incorporated to take over the business of the Northey Mfg. Co., Ltd., of Toronto; the capital to be $350,000.

The N. L. Piper Railway Supply Co., Ltd., has been incorporated to take over the business of Noah L. Piper & Son, Toronto; capital, $40,000.

The Dry Dock & Wrecking Co., Collingwood, Ltd., has changed its name to The Ship Building, Dry Dock and Wrecking Co., of Collingwood, Ltd.

The Haliburton Lumber Co., Ltd., has been incorporated; capital, $50,000; provisional directors are, G. P. Magan, W. D. Thomas, and F. P. Brazill.

Reinhardt & Co., Toronto, have bought about 40,000 square feet of land, at St. Paul St. and Dupre Lane, Montreal, and will build a brewery, costing, it is said, $150,000.

Blakely & Ross, who are interested in brickmaking at Orangedale, C.B., have sold out their business at Halifax, and will confine their attention to brickmaking.

An emery wheel in the Frost & Woods' works, Smith's Falls, Ont., burst March 5th. This is the third accident of this sort in these works in a period of a few months.

H. H. Gervan, W. Northwood, C. J. Smith, N. C. Sparks, J. I MacCraken, Ottawa, Ont., have been incorporated as the Ottawa Furnace & Foundry Co., Ltd.; capital, $40,000.

A. E. Gazlay, A. E. Rea, Adele Bishopric, and V. Bishopric, Toronto; Lydia Gazlay, Cincinnati, O., have been incorporated as The Victoria Paper Box Co., Limited; capital, $20,000.

Doolittle & Glazier, formerly employees of D. Hibner & Co., furniture manufacturers, have formed a partnership, and are about to build a furniture factory, 60 by 150 feet, four stories high, in Berlin, Ont.

The Sanitation and Utilization of Sewage Company Ltd., Montreal, has been incorporated; capital, $50,000; for the utilization of sewer waters for irrigation purposes G. Janin, J. A. C. Madore, A. Stuart, J. B. Lapointe, I. L. Lefleur, of Montreal, incorporators.

C. W. Price is working at a steam carriage in his shop on Simcoe street, Toronto, near Adelaide street, and is said to have interested large capitalists in Montreal.

G. G. Roe, P. S. Roe, R. C. Roe, W. Edwards, and J. H. Gervan, Ottawa, Ont., have been incorporated as the Baldwin Iron Works, Ltd.; capital, $40,000; to manufacture engines, machinery, electrical plants, etc., in Ottawa, Ont.

W. A. Farrow, D. W. Moore, H. S. and H. E. White, W. Waldron, W. W. Woods, N. McAlpine, R. H. Riley, and F. Hehn, Brantford, Ont., have been incorporated as the Mechanics' Fuel Co., of Brantford, Ltd., to deal in peat, etc.

A. Pequegnat, P. Pequegnat, R. D. Lang, and S. Groh, Berlin, Ont.; L. G. Pequegnat, New Hamburg, Ont.; J. U. Pequegnat, Guelph, Ont.; and James Pequegnat, Stratford, Ont., have been incorporated as the Berlin and Racycle Mfg Co.; capital, $49,000.

The Dominion Government has recently made soundings in the Ottawa river at Des Joachims rapids, to locate the proposed new bridge to which $15,000 has been voted. The Ontario and Quebec Governments will give $5,000 each, and $10,000 will be subscribed by local capitalists.

The School of Practical Science, Toronto, will get $23,870, instead of $22,470, from the Ontario Government this year, and the professor in engineering will get $200 additional, and the lecturer in surveying $100, also the lecturers in electrical engineering, applied mechanics and mining.

The United States pipe trust is said to be shipping freely to Canada, in order to injure the Canadian makers, who are entering the United States market and finding ready sale for their pipe. Canada will cut very seriously into the United States iron trade in more than pipe when plants now contemplated come into competition.

The new iron and steel company being formed in Collingwood, Ont., by United States capitalists, among whom are several of the shipbuilding family of Philadelphia, the Cramps, has had voted a bonus of $115,000 by the town, and other inducements, such as a fine site, will be granted. The vote in favor of the bonus was very large.

The Dominion Leather Board Co., of Montreal, has put in a new 200 h.p. engine, made by the Jenckes' Machine Co., into their mills at Sault au Recollet. A new beating engine for the leather board works is also being put in, and the capacity of the works will now be one ton per day each for the leather board and paper mills. Both branches are now running night and day.

Hon. J. Dryden, Brooklin, Ont.; C. Mills, Hamilton, Ont.; D. Henderson, Acton, Ont.; W. McGregor, Windsor, Ont.; F. Fenton, M.D., Toronto, Ont.; J. H. Douglas, Warkworth, Ont.; and J. G. Boucher, London, Ont., have been incorporated as the Dominion Fence Co., Ltd., to make and deal in wire fencing, metal roofing, and siding, etc.; capital, $750,000; head office, Toronto.

Wm. R. Perrin & Co., of Chicago, have started manufacturing their goods in Canada, and have leased the plant of the Ontario Engine & Machine Co., on Richmond St. East, Toronto. J. F. Lawson, well-known to the Canadian consumers of their goods, is in charge. Mr. Holmes, of the Chicago plant, has been appointed mechanical superintendent. Their office is at 122 Church St., Toronto.

A great shipbuilding industry is proposed for Halifax, N.S., to use steel made in Sydney, C.B. The promoters speak of a capital of $20,000,000. What reason there might be for locating the ship yard so far from the source of materials is hard to see. Perhaps the people of Halifax may grant a large bonus, but otherwise it would seem natural for a shipbuilding company to avail itself of the great advantages of Sydney for such an industry.

Charles Meyers, Ottawa, who is promoting an iron smelter in Kingston, has made the following offer to that city: The company would put up a smelting works plant worth $225,000, with a capacity to smelt from 100 to 200 tons of iron ore daily; they would employ from 100 to 200 hands; they would transfer their offices, etc., there; they would pay from $100,000 to $150,000 yearly in salaries. In return, they asked from the city a free site, exemption from taxation, and a bonus of $4,000 yearly for fifteen years.

The Midland, Ont., Elevator Co. is taking out its old steam plant and putting in a new engine and boiler.

Hamilton, Ont., is to go on with its $200,000 third water main, which was voted on recently.

McLachlan Bros., Arnprior, Ont., have had their saw mills' assessment fixed at $100,000 for ten years, and $225,000 for another period of ten years.

The McLachlan Electric and Gasoline Motor Co. is busy constructing a gasoline carriage, to be worked with a double-cylinder, non-vibrating motor.

The Winnipeg Commercial states that D. McLean has organized a company to build a 200 bbl. flour mill, and a 50,000 bushel elevator at Moose Jaw, N.W.T.

A Scotch firm writes the Canadian Government offices in London, asking for names of Canadian exporters of broom, hoe, and shovel handles, prices to be quoted for car lots.

McGregor & McIntyre, the Builders' Iron Works, 65 to 71 Pearl street, Toronto, make a specialty of jail cells, iron sidewalk doors and fire escapes. They are well equipped for supplying all classes of builders' iron work.

W. T. Jennings, C.E., has been retained by Toronto to co-operate with the Dominion Government engineer, J. R. Roy, C.E., in preparing plans for the improvement of Toronto harbor.

George J. Dickson, Alex. Robinson, David Sadler and A. G. Dickson are a committee to secure the establishment of a $2,000 butter factory at Napan, N.B., under the auspices of the Farmers' and Dairymens' Association.

The Hamilton Brass Mfg. Co., has sold its cash register business to the American National Register Co., Dayton, O., for about $250,000. It is said the United States monopoly will establish a large factory in Hamilton, Ont., to employ some 200 hands.

The town of Fort William, Ont., has granted a bonus of $50,000 to the Mattawin Iron Mining Company, which is to erect a blast furnace on the banks of the river, and also one of $25,000 for a copper refinery, providing construction is commenced within six months, and finished inside of two years.

Application has been made for letters patent by the Imperial Cotton Company, of Hamilton. Among the directors of the new concern, which is to have a capital of $750,000 are W. D. Long, J. M. Young and Alfred Morgan, Hamilton, Ont., and C. T. Grantham, of Yarmouth, N.S.

J. N. Tallman & Sons, Hamilton, Ont., are enjoying a very much increased business in the manufacture of machinery, ornamental brass, phosphor bronze, zinc, copper, aluminum and aluminum bronze castings, etc. The new building, which has just recently been completed, is one of the largest and best equipped brass foundries in Canada. Among the improvements is a smelting furnace of 3,500 lbs.' capacity, for the manufacture of large phosphor bronze castings, etc. Having made extensive improvements for this class of work, orders can be filled on short notice.

The John McDougall Caledonia Iron Works, Ltd., Montreal, has been incorporated; capital, $500,000; to deal in iron and iron ore, to carry on the business of mechanical engineers and manufacturers, and to acquire the business now carried on under the name of John McDougall Caledonia Iron Works. The charter members are: E. M. McDougall, Agnes K. McDougall, Jessie E. McDougall, F. C. Henshaw, L. B. McDougall, wife of J. D. Hayden, Cobourg, Ont., and R. Cowans, Montreal.

Two hundred men employed by the Hamilton Ont., Steel and Iron works, went out on strike March 31st, causing the laying off of 150 other workers and the closing of the works. The strikers were employed as finishers in the nine and ten-inch mills and claim that under the western scale of the Amalgamated Association of Iron and Steel Workers of America, they were entitled to an advance of 4 per cent. in their wages on March 1st, and as this advance was not received, they struck. The workers in the finishing departments number 150 and were compelled to quit work when the other men went out. The men employed at the Hamilton Bridge Works struck a short time earlier. The works are being overhauled, taking advantage of the men's absence.

The use of steel in large buildings is causing an increased demand for hoisting engines. In the past year M. Beatty & Sons, Welland, Ont., have supplied eight special hoisting engines to the Dominion Bridge Co., and in one month four to the Dominion Iron & Steel Co., Sydney, C.B. The United Coal & Coke Co., Sydney, C.B., has bought one such engine, and the revolving and travelling derricks are now being built in Welland for the Hamilton Steel & Iron Co., for unloading at the docks in Hamilton.

The Still Motor Co., Ltd., 710 to 724 Yonge St., Toronto, has been purchased by English capitalists, who are forming a large company, called "Canadian Motors, Limited." The factory is crowded with orders for twelve months ahead. The automobiles manufactured are motets, Gladstones and delivery wagons, equipped with motors, batteries and controllers, under the Still patents. W. J. Still, the inventor, is now in England with the Oxford carriage, which was manufactured here. To Thomas Bengough is due the chief credit for the successful flotation of the Still business.

The seventy-third meeting of the Mechanics' Society, of Newfoundland, was held in St. John's last month. The reports from the Higher Council and officers showed the institution to be flourishing, that of the former expressing a removal of certain disabilities under which the boiler-makers and tanners labored. The officers installed were: President, T. M. White; vice-president, J. P. Scott; 1st assistant, C. Nurse; 2nd assistant, T. Rourke; treasurer, M. W. Myrick; 2nd treasurer, James Beck; 3rd treasurer, J. Goodland; secretary, J. J. Mullaly; grand marshal, Peter Stapleton.

A trial was made last month of the pumping plant of the Verdun, Que., sewerage system. This plant consists of an eighteen-inch centrifugal pump of the Northey Manufacturing Co.'s make, and a boiler and engine from the Caledonian Iron Works, Montreal. The engine pulley is ten feet in diameter and eighteen inches face, that of the pump shaft being forty inches by eighteen, the whole housed in a neat brick building, fifty by forty feet. (The purpose of the pumping plant, it should be said, is to get rid of the sewage when the river is at flood). The stipulated delivery by the pump was exceeded in the actual working, and the entire plant met with approval.

At the sixth annual meeting of the Nova Scotia Steel Company, the directors' report showed that business done in 1899 was the largest in the company's history. A dividend of four per cent. on preferred stock for the half year ending December 30th, 1899, was declared. On this stock four per cent. had previously been paid in June, 1899, and 24 per cent. in August, 1899. The dividend just declared makes 32 per cent. earned by preferred stock for the year, and pays all accrued dividends up to 1900; 8 per cent. was declared on common stock, payable March 10th. This is the first dividend paid on ordinary shares since the amalgamation of the company in 1895. The profits for the year, after paying floating debt, 28 per cent. dividend on preferred stock, and $75,300 bonds, were $819,945. In these profits, of course, are included $1,000,000, the price of the iron ore mine at Wabana, Nfld., sold by the company to the Dominion Iron & Steel Company.

A meeting of the organizers of the Canadian Steel Company, the incorporation of which, with $18,000,000 capital, $3,000,000 preferred, is now pending, was held in this city this week, says The Journal of Commerce, New York, under date March 28th. At this meeting details of the organization were agreed upon, although the formal organization cannot be effected until the charter has been actually issued, which it is expected will be done about the 20th of next month. The plant of the company will be at Welland, Ont., where a 1,500 acre site has been obtained. This is at the mouth of the Welland Canal, where it is said Lake Superior ores can be laid down as cheap as at Cleveland or Buffalo. The company proposes to enter into practically all departments of the iron and steel business. Among those interested are several capitalists from this and other cities of the United States, while Canadian capital is also concerned. A feature of the company's charter is that it will permit the company to make contracts for electric power with the Hamilton and Lake Erie Power Company, specifically, or with other companies. It is claimed that power can be furnished in this way at about one fifth the cost of steam power in Pittsburg.

A Wren & Co.'s foundry, Forest, Ont., was burned, March 29th; loss about $5,000.

John Wheeler, needle maker, Paris, Ont., is asking for exemption from municipal taxation.

J. K. Brydon, Rat Portage, Ont., is to build a business block, part of which will be occupied by the Bank of Ottawa.

Simon Peters Co., Ltd., is to be incorporated to do business in Quebec as general contractors, lumber merchants, etc.; capital, $100,000.

The Montreal Rolling Mills were badly damaged by fire, March 24th. The business of the company will not be delayed however. The capital of the company will be increased to $750,000.

M. H. Frost, A. R. Gilbert and J. Brown, Cleveland, U.S.; H. L. Frost, and Clara M. Frost, Welland, Ont., have been incorporated as the Frost Wire Fence Co., Ltd.; capital, $40,000; chief place of business, Welland, Ont.

C. J. Anderson, P. Stenins, G. Everson and W. A. Carlson, Detroit, U.S.A., and A. Lovett, Colchester, North Essex Co., Ont., have been incorporated as the Walkerville Match Co., Ltd.; capital, $100,000; chief place of business, Walkerville, Ont.

A. Bell, judge; A. Park, J. Piggott, M. Wilson, Q.C.; E. R. Smith, W. F. O'Hara, D.L.S., Chatham, Ont.; S. A. King, Kingsville, Ont.; R. Aikin, J. I. Wiley, M.D., Dresden, Ont.; T. L. Pardo. and W. D. Samson, Blenheim, Ont., are incorporated as the Western Peat Fuel Co., Ltd.; capital, $100,000.

J. Hewer, H. H. O. Stull, T. Davidson, W. E. Buckingham, and W. J. Hammill, Guelph, Ont.; A. J. McPherson, Stratford, Ont.; and R. M. Duvall, Springfield, Mass., have been incorporated as the Ontario Seed and Grain Separator Co., Ltd., to make agricultural implements; capital, $40,000; chief place of business, Guelph, Ont.

Redpath-Reid automatic smoke consumers have recently been supplied by the Jubilee Grate Bar Co., Ltd., to the following among others: A. & J. Clark, Bullock's Corners, Ont.; Dunn Spice Mills, Hamilton, Ont.; Hamilton Times, Hamilton, Ont.; T. Upton & Co., Hamilton, Ont.; Penman Mnfg. Co., Paris, Ont.; R. G. McLean Printing Co., Toronto; Verity Plough Co., Brantford, Ont.; Pugsley, Dingman & Co., Toronto Junction, Ont.; Kingdon, Smith Co., and Victor Soap Works, Hamilton, Ont.; P. W. Ellis & Co., Toronto. The company also reports an unprecedented demand for shaking grates.

The Cummer mechanical dryer is approved of by the Fraser River Oil and Guano works, Vancouver, B.C., which writes to the F. D. Cummer & Son company: "The 'F' dryer will easily dry from 50 to 60 tons of fish scrap per day of 24 hours. It is very satisfactory and economical of fuel and labor. It is the best on the market." The Trent Valley Peat Fuel Co. states that a Cummer dryer "evaporated at the rate of 4,565 pounds of water per hour; consumed 414 pounds of combustible per hour; one ordinary workman operates the entire dryer plant. The product obtained is uniformly dried and in excellent condition for pressing."

An explosion occurred at the gas works of the Listowel Gas and Electric Light Company, Listowel, Ont., March 23rd, at 11.30 o'clock p.m. The generator blew up and wrecked the building. The engineer of the works, William Bitton, was in the building at the time, and was carried out before the fire, which at once followed the explosion. He was badly injured, one of his thighs being fractured, and his body being cut and terribly bruised in different places. The force of the explosion shattered all the windows in the neighborhood, and broke plate glass more than a quarter of a mile away. The electric-light plant was in the same building, and was also completely wrecked. The gas company last summer put in a new plant, changing from oil gas to water gas. The insurance was $3,000 on the gas plant, and $800 on the electric light plant.

The Smart-Eby Machine Co., Ltd., is at present working on the following orders: Twelve electro reduction baths, two mixing machines 6-ft. by 12-ft., ten steel tanks 12 ft. diameter by 10-ft., one 30,000 lbs. travelling crane, one 30 h.p. boiler fitted with Rodgers patent shaking and dumping grate bars, 350 feet steel shafting with hangers, etc., for the Hoepfner Refining Co; one 50,000 lb. travelling crane, and 800 rain proof pulley blocks for the Hamilton Electric Light & Cataract Power Co; two alligator shears, each direct connected to its own engine; one 7½ x 4½ x 10 outside packed boiler feed pump, ten steel charging buggies, one ladle heater, for the Hamilton Steel & Iron Company, two travelling radial drills with 20 foot arms for the Hamilton Bridge Works Co., one ten h.p. high speed vertical engine, one 20 h.p. boiler with Rodgers' patent shaking and dumping grate bars, with shafting, pulleys, etc., for the Hamilton City Hospital laundry; one end bending machine for bending extra heavy bob runners, and one stack bender for bending wagon shafts, for F. W. Hore Sons; one eight can drying machine for the Guelph Carpet Mills Co.; one double disk sander for the Ontario Box Co.; one internally fired boiler for Smith & Baker, Dundas, Ont.

Railway Matters.

R. Sheehy, Peterborough, is building the new Roman Catholic church in Campbellford, Ont.

Reid McManus, C.E., is in charge of the ten-mile contract on the P.E.I. Railway, held by his father, J. W. McManus.

The Grand Trunk Ry. Co. has adopted the new Milne cushion truck brake for use on the passenger rolling stock.

The freight bill of the Dominion Iron & Steel Company, of Sydney, C.B., for the month of January, amounted to something over $82,000, it is said.

The C.P.R. has ordered from the car shops at Perth 100 standard 30-ton flat cars, 200 standard 30-ton box cars, 75 standard 30-ton refrigerator cars for freight service, and 25 refrigerators for the passenger service. The order is to be completed by the 1st of June.

During the present year, the Grand Trunk Ry. Co. intends to expend $800,000 on the Midland Division, to include a new station at Queen street east, Toronto, a new turn table at the round-house, and the double tracking of the line from Niagara Falls to Hamilton, Hamilton to London, and London to Sarnia.

The Great Northern Ry., for which John Ross, Toronto, has the contract, will be finished by August 1st. The bridge at Hawkesbury will be a prominent feature. One span of the steel work has already been put in position. Forty miles of the road have been operated this winter between St. Jerome and Ste. Elizabeth, Que.

The Canada Atlantic Ry. shops at Ottawa, in which work was interfered with a short time ago owing to the scarcity of material, have resumed operations, and are now running on regular time. The company proposes to build about seven hundred freight cars before July 1st, and the heavy undertaking will necessitate the permanent employment of a large staff of men.

The Canadian Pacific Ry. is surveying a new route from Ottawa to Arnprior, Ont. The present road from Arnprior to Ottawa, by way of Carleton Place, is almost double the distance of the proposed short line. The proposed new road is to run parallel with the Ottawa river, and between it and the Ottawa, Arnprior and Parry Sound Ry., traversing the townships of Tarbolton and Fitzroy.

Two branch lines of railways are likely to be built in the Ottawa Valley during the coming season, one to be known as the Bancroft and Pembroke Ry., is to be built from the former to the latter place to connect with the Canada Atlantic Ry. at Pembroke, shortening the distance from Pembroke to Toronto over 80 miles. At Bancroft the line would connect with the Grand Trunk Ry. The other is the North Lanark Ry., which will run from Mud Lake on the Kingston and Pembroke Ry. to Arnprior, and there connect with the C.P.R and C. A. Rys.

The Grand Trunk Ry. will rebuild the International bridge over the Niagara river at Black Rock, below Buffalo. The bridge was built in 1870. The official announcement states that arrangements have been made for the renewal of the superstructure of the bridge, the property of the International Bridge Co., controlled by the Grand Trunk. There are two independent structures. One is the bridge across the Niagara proper, the other across Black Rock Harbor. The bridge

across the river consists of eight spans and has a length of 1,967 feet. Two openings are bridged by the arms of the draw girder, which has a length of 362 feet. The bridge across Black Rock Harbor is 517 feet. The draw span of this bridge has an opening of 107 feet. This work is being done to meet the requirements of the increasing weight of rolling stock. The contract is let to the Detroit Bridge and Iron Works.

At the annual meeting of the C.P.R., held April 4th, a statement including the following was made: A balance sheet of the affairs of the company at December 31st, 1899, shows the gross earnings for the year were, $29,230,038.26; the working expenses were $16,999,872.77; and the net earnings were $12,230,165.49. The working expenses for the year amounted to 58.16 per cent. of the gross earnings, and the net earnings to 41.84 per cent., as compared with 59.92 and 40.08 per cent. respectively in 1898. The earnings per passenger per mile were 1.79 cents, and per ton of freight per mile 0.74 cents, as against 1.52 and 0.76 cents respectively in 1898. During the year, two hundred and seventy-four miles of the main line were relaid with steel rails weighing seventy-three and eighty pounds per yard. The land sales for the past year were 416,806 acres for $1,327,667, as against 348,608 acres, for $1,121,774, in 1898.

Electric Flashes.

The Record Printing Co., Windsor, Ont., has bought from the Electrical Construction Co., London, Ltd., a 40-light multipolar dynamo.

J. A. Humphrey & Co., Toronto watch case manufacturers, have installed a new plating dynamo of the Jones & Moore Electric Co.'s manufacture.

The new firm of Raney Specialty Mnfg. Co., Kingston, Ont., has bought from the Electrical Construction Co., London, Ltd., three motors for its new works.

The Erie Iron Works, St. Thomas, Ont., has ordered from the Electrical Construction Co., London, Ltd., a 12 h.p. motor, which has already been installed to their satisfaction.

The Electrical Construction Co., London, Ltd., has sold twenty-two of the list of eighty second-hand machines which were recently exchanged for new ones in Winnipeg.

The installation of the electric lighting plant at the dry-dock sub-station, St. John's, Nfld., is under the superintendence of W. A. Mackay. The entire plant is supplied by the Westinghouse Electric Co.

The W. J. Gage Co., Toronto, has bought two new motors from the Electrical Construction Co., London, Ltd., in addition to the two slow speed press motors which had already been bought from this company.

H. McCulloch, sr., has retired from the board of directors of the Galt, Preston & Hespeler Ry., and M. N. Todd has been elected president in his stead, and G. Forbes, of Hespeler, a director. W. H. Lutz was re elected secretary treasurer.

The Nova Scotia Electric Light Co. has had a second survey made of the source from which it is intended to derive the electrical power for the Annapolis Valley. The engineer's report was satisfactory, and the company is making plans to commence work at once.

The Shawenegan Carbide Company, Ltd., has been incorporated with a total capital stock of $1,000,000, the charter members being: D. D. McTavish and T. L. Wilson, St. Catharines; A. E. Plummer, John Payne and Wm. Gilchrist, Toronto, and Clarkson Freeman, Merritton, Ont.

At the annual meeting of the Hoepfner Refining Co., Hamilton, Ont., the following officers and directors were elected: Hon. J. M. Gibson, president; J. V. Teetzel, Q.C., vice president, J. Patterson, secretary; J. Moodie, sec. treas., Carl Hoepfner, H. R. Leyden and A. T. Wood, M.P.

Work has been started on the construction of the new power transmission line to run along the mountain from the Cataract Power Co.'s station at DeCew's Falls to Hamilton, Ont. The work was commenced just south of Stoney Creek, and it is expected that the line will be ready for operation July 1st.

J. A. Culverwell, Toronto, has been appointed managing director of the Central Ontario Power Company (proprietors of the Burleigh Falls water power), of which Hon. R. Harcourt and Hon. Peter McLaren are directors. Mr. Culverwell has moved from Toronto to the company's office at Peterborough.

The new Century lamp guard, which is being placed on the market by the Packard Electric Co., Ltd. St. Catharines, Ont., is attracting favorable notice on account of the convenience in packing, as they nest and so occupy much less space than otherwise. The socket fastenings are the same as on the Perfection guards.

Iron trolley pole brackets are now being manufactured in Canada by the Builders' Iron Works, 65-71 Pearl street, Toronto. This concern also carries in stock steel and iron bars, steel angles, channels, tees, etc., and are prepared to tender on any builders' iron work, fire escapes, etc., which the completely equipped plant enables them to produce at short notice.

The Jones & Moore Electric Co. has recently booked orders for complete warehouse private telephone systems for G. R. Renfrew & Co., Watson & Co., Wyld, Grasett & Darling, Monetary Times, all of Toronto; A. A. Matthews & Co., have placed an order with the Jones & Moore Electric Co., for a complete lighting plant, dynamo, engine and marble switch-board for their new steamer "Tilly."

The London Cold Storage and Warehousing Co., London, Ont., has ordered from the Electrical Construction Co., London, Ltd., a 30 k.w. direct connected generator and engine for 250 volt service to supply the lights of the building and two motors of 10 and 15 h.p. respectively, which have also been ordered of the Electrical Construction Co., London, Ltd., of the Perfection type multipolar machines.

The Jones & Moore Electric Co. has recently furnished the following manufacturers with electric motors: Barchard & Co., G. Wellings, C. Wilson & Son, Hemming Bros., Turnbull & Russell, J. S. Bennett, A. R. Williams Co., R. A. Winton, Elliott Mnfg. Co., Chandler & Massey, Minerva Mnfg. Co., Bradshaw & Co., J. E. Dunham, J. E. Ellis & Co., the Featherbone Corset Co., Sexton & Co., J. Cohen.

The cable steamer "Faraday" finished landing at Canso, N.S., the short end of the new cable for the Commercial Company, which is to connect Canso with the Azores. Alexander Siemens, director of the celebrated firm of cable manufacturers, which has a contract for this work, personally superintended the work of landing the cable, which was successfully accomplished. The "Faraday" then proceeded paying out the cable, which will land at Fayal.

The Kneeland Reflector Co., 222 Friend street, Boston, Mass., manufacturer of reflectors, is putting on the market a new shade called Hood, and carries a stock of finished goods in silver bronze, green bronze and green enamel. All the goods manufactured by this company are said to be standard and can be relied upon to give satisfaction. S. R. Kneeland, of the company, is the original manufacturer and patentee of reflectors known for ten years as McCreary Standard Reflector Shades.

Judgment was given in the Court of Appeal last month in the case of Harris v. Toronto Electric Light Co. Judgment on motion by plaintiff for order directing that upon the new trial directed by the court to take place, the sole question to be determined shall be how the fire which destroyed the plaintiff's premises was caused. Order made directing a new trial generally on all questions raised, except that of damages. Costs of this motion to be considered as part of the costs of the appeal. J. B. Clarke, Q.C., and Swabey for plaintiff. Aylesworth, Q.C., E. F. B. Johnston, Q.C., and Henry O'Brien, Q.C., for defendants.

The Lachine Rapids Hydraulic and Land Co. has within the last two months installed three new generators of 1,000 h.p. each, and a fourth generator of the same power is now on the way, thus increasing the capacity of the works by 4,000 h.p. This machinery was supplied by the Canadian General Electric Co. Some changes have recently been made in the method of driving the exciters at the power house. Instead of being driven from the main shaft they have been put in brick buildings and driven by independent wheels. The company has recently put in lathes, drills and a planer, and have equipped a blacksmith shop, these to be used as a repair shop.

The Chambly Power Co. proposes to build a second dam across the Richelieu River, about two miles above the present dam. This new work will serve the double purpose of preventing the occasional formation of frazil ice at the lower dam, and will furnish 9,000 or 10,000 additional horse-power for transmission to Montreal. It is expected that the Montreal Street Railway will take at least a part of this new supply of electricity. At present at certain hours of the day the demand for lighting and manufacturing purposes takes all the current sent to Montreal, but at other hours much goes to waste; but it is proposed to store the waste power in storage batteries, and use it all up in the hours of greatest demand. It is expected that the plans will be settled on the return, from England, of Mr. Ross, who is interested in both companies.

At the twentieth annual meeting of the Bell Telephone Company of Canada the annual report showed that 2,841 subscribers had been added during the year, the total number of sets of instruments now earning rental being 34,923. The company now owns and operates 343 exchanges and 450 agencies. To the long distance system, 1,686 miles of wire were added in 1899. The net revenue for 1899 was $353,307.40, the dividends amounted to $312,920, leaving a balance of $40,387.40, which, added to the balance revenue from 1898 of $149,735.98, leaves $190,123.38 to be carried forward to 1900. The plant and patents to the end of 1899 are valued at $5,244,436.33. The following directors were elected: C. S. Sise, president; Chas. Cassils, R. Archer, Robt. Mackay, vice president; H. Paton, W. R. Driver, John E. Hudson and T. Sherwin.

Personal.

W. F. Van Buskirk, C. E., has been appointed city engineer of Rossland, B.C.

Wm. Reid, a well-known contractor and builder, Montreal, died last month at the advanced age of 82 years.

Kenneth Mackenzie has spent some time in Canada recently and will report upon the Ottawa-Georgian Bay Canal plans.

The secretary of the Petrolea Electric Light Co., Walter McDonald, died at his home in Toronto, recently, after a short illness.

George Simpson, assistant engineer of the Northern Pacific Ry., has resigned his position to accept the position of chief engineer of the Manitoba Provincial Government.

H. F. Duck, manager of the Engineering Contract Co., Temple Building, Toronto, was among those injured in the C.P.R. accident at Myrtle, Ont., last month. Mr. Duck has entirely recovered.

The employees of the Verity Plow Co., Brantford, made a handsome presentation to R. H. Verity, manager of the company, on the occasion of his resignation to accept the position of assistant manager of the Massey-Harris Co., Ltd.

Locomotive Foreman John Donnelly has been transferred from the G.T.R. yards at York, Ont., to Montreal, where he will succeed G. Blackbird, who was formerly locomotive foreman at that point. Traveling engineer W. Newcome will take John Donnelly's place at York.

Wm. Wallace, of Prescott, an old employee on the C.P.R. between Ottawa and Prescott, died suddenly from a stroke of paralysis a short time ago. He was stricken while being presented with a gold watch and chain by a number of his fellow-employees on the C.P.R.

S. Walker, who has been for almost 17 years foreman in the G.T.R. workshops, Point St. Charles, Montreal, was presented with a silver tea service, a marble clock and a bronze lamp by the employees, on his leaving the employ of the G.T.R. to become general foreman of the Dominion Bridge Co.

R. M. Wanzer, founder of the Wanzer Sewing Machine Company, of Hamilton, Ont., died in New York on the 23rd ult. Mr. Wanzer was one of Hamilton's wealthiest and most progressive citizens, and was at one time principal owner of the Hamilton Electric light plant, and also manufactured the Wanzer lamp. Business reverses overtaking him, his fortune was soon used up and latterly he had lived in the United States.

A. P. Polson, son of William Polson, of the Polson Iron Works Co., Toronto, was almost instantly killed at Pittsburg a short time ago. Mr. Polson had charge of one of the departments in Jones & Laughlin Co.'s steel works, and while superintending the construction of a large engine was struck on the head by a flying piece of iron. He was 37 years of age, and served his apprenticeship in his father's works. He left Toronto about a year ago for Pittsburg.

G. B. Reeve, the general traffic manager of the Grand Trunk, will leave the service of the company on the last day of this month, and enter upon a new life which he has been planning for the last twenty years. That life will be spent amid orange groves and grape fruit, in a temperature which will be equable the year round, and in an environment which will realize an ideal Mr. Reeve has long cherished. He will retire to his splendid property near Los Angeles, Cal.

The many friends of Alexander Fraser were much grieved by his death last month in Toronto. He was the son of the late Archibald Fraser of Fraserfield, Glengarry, and 42 years of age. Mr. Fraser has been treasurer of the Boiler Inspection Insurance Company for a number of years. He was one of the oldest and most enthusiastic members of the Argonaut Rowing Club, and was exceedingly popular among his fellow-members, having held the position of treasurer for over ten years. He was a first-class oarsman, and was president of the Northwestern Rowing Association.

Thomas Henry, district passenger and Canadian freight agent of the Northern Pacific Ry., with headquarters in Montreal, has been appointed general traffic manager of the Richelieu & Ontario Navigation Company, in the place of the late Geo. Brown. Thomas Henry, who is 32 years of age, and a native of Montreal, entered the employ of the Ottawa River Navigation Company about twenty-one years ago, and later on that of the Grand Trunk Ry., working for the latter at the ticket office on St. James street. For the past fifteen years he has been with the Northern Pacific Ry., for ten years holding the appointment he is now resigning.

Marine News.

Tug "T. Maitland," built last winter at Owen Sound, Ont., sunk at her moorings last month in 15 feet of water.

J. B. Fairgrieve & Co., Hamilton, have appointed on the steamer "Arabian," Captain O. Patenaude, and Engineer Jas. Smeaton.

The Matthew's Line, Toronto, has appointed to the steamer "Clinton," Capt. W. J. Shaw, Engineer George Wilcox.

The Montreal Harbor Board have been discussing the possibilities of an ice breaker for use between Quebec and Montreal in winter. The Karmak model is suggested.

The issue of $386,000 new stock by the Richelieu & Ontario Navigation Company has all been subscribed privately by the present shareholders, and will not be offered to the public.

Richard Williamson, Niagara Falls, N.Y., who has bought the steamer "Myles," from Thos. Myles' Sons, Hamilton, Ont., has appointed J. O. Moore captain for this season.

North-West Transportation Company, Ltd., Sarnia, Ont., has appointed on the steamer "Monarch," Captain E. Robertson, Engineer Thomas Bard; and on steamer "United Empire," Capt. John McNab, Engineer S. Brisbin.

The St. Lawrence & Chicago Steam Navigation Co. has appointed to the steamers "Algonquin," Capt. James McMaugh, Engineer James H. Ellis; "Rosedale," Captain Jas. Ewart, Engineer Edward O'Dell.

At the annual meeting of the Richelieu & Ontario Navigation Company the report of the president and directors for the year ending December 31st, 1899, was as follows: The gross receipts were $828,322.06; 1898, $728,043.07. Operating expenses, 1899, $674,626.89; 1898, $590,036.53. Fixed charges, 1899, $24,966; 1898, $25,070.80. Net profit, 1899, $128,730.07; 1898, $112,027.55. Two semi-annual dividends of 3 per cent. each, amounting together to $104,400, were paid, leaving the amount of $24,330.07 carried to surplus.

James Playfair & Co., Midland, have made these appointments for this season: Steamer "St. Andrew," Capt. W. H. Featherstonhaugh, Engineer Thos. Crossley; steamer "Magnolia," Capt. R. H. Gilbertson, Engineer A. E. House; steamer "Metamora," Capt. James Tindell, Engineer George N. Smith; steamer "Minataga," Capt. Edward Burke, Engineer James McGregor; steamer "Margherita," Capt. James O'Connor, Engineer Henry Hewitt.

The Northern Navigation Company, of Ontario, Ltd., has made the following appointments for the season of 1900:

Steamer.	Captain.	Engineer.
Majestic	P. M. Campbell	W. J. Asten
City of Collingwood	W. J. Bassett	C. Robertson
City of Midland	F. X. La France	Wm. Whipps
Germanic	R. D. Foote	Jos. Asten
City of Toronto	John O'Donnell	D. McQuade
Atlantic	Jas. Wilson	H. Clelland
City Parry Sound	Ernest Walton	James Smith
Britannic	C. A. Jacques	Samuel Beatty

The Toronto Ferry Co., Ltd., has made these appointments for the season:

Steamer.	Captain.	Engineer.
Mayflower	G. Moulton	E. Abby
Primrose	R. Williams	S. A. Mills
Shamrock	T. Jennings	Isaac Jamieson
Thistle	A. Martin	W. Hopkins
Island Queen	M. Corcoran	T. Good
Luella	C. H. Tufford	J. Smiley

The following appointments have been made in the Montreal Transportation Co.'s fleet for season of 1900:

Steamer.	Captain.	Engineer.
Active	John Gaskin	John Hamilton
Bronson	Joseph Murray	Robert Hepburn
Bannockburn	Alex. Milligan, Jr.	Richard Taylor
D. G. Thompson	Jas. Murray	Geo. Henderson
Glide	Thos. Murphy	M. Rankin
Glengarry	Gordon Kean	Chas. Napper
Jessie Hall	Chas. Martin	Geo. Tuttle
Rosemount	Jas. Mawdesley	John Evans

The Calvin Co., Ltd., Garden Island, Ont., has made the following appointments for 1900:

Steamer.	Captain.	Engineer.
India	A. H. Malone	Thos. C. Smith
Bothnia	Geo. A. Brian	Robt. Veech
D. D. Calvin	Chas. Coon	W. H. Cunningham
Reginald	John Doyle	John Kennedy
Chieftain	John Sullivan	Thos. Gray
Parthia	David Lefave	George Sauvé
W. Johnston	Chas. E. Felix	Thos. Campeau
Blue Bell	John Dix	Chas. Le Riche

The Richelieu & Ontario Navigation Co. has made the following appointments to the various steamers of the fleet for this season:

Steamer	Captain.	Engineer.
Quebec	L. O. Boucher	F. Gendron
Montreal	L. St. Louis	F. X. Hamelin
Berthier	C. Gonin	E. Arcand
Terrebonne	E. Gonin	A. de Martigny
Chambly	J. A. S. Paulet	C. Gendron
Three Rivers	F. St. Louis	J. Matte
Laprairie	P. McLean	G. Gendron
Hochelaga	H. Mandeville	F. Chapdelaine
Longueuil	F. Jodoin	N. Beaudet
Hosanna	D. Mongeau	E. Gendron
Mouche a Feu	F. Crepeau	B. Plantal
Sorel	A. Berthiaume	F. Beaucage
Saguenay	C. Lapierre	P. Hamelin
Canada	Jos. Dugal	F. Denis
Carolina	G. Riverin	M. Latulippe
Toronto	H. Esford	Wm. Black
Hamilton	A. J. Baker	R. Marshall
Spartan	H. P. Grange	N. Beaudin
Corsican	John McGraw	W. Parker
Algerian	D. Mills	Hazley
Bohemian	A. Dunlop	A. R. Milne

The Georgian Bay Navigation Co. has recently ordered a 300-light dynamo from the Electrical Construction Co., London, Ltd., for one of its boats, to take the place of a 150-light dynamo installed two years ago by the same company, which has given every satisfaction.

It has been announced that in order to meet the requirements of its growing trade, between Cape Breton and Boston, Mass., the Dominion Coal Company has decided to have three large steamers built in Newcastle, Eng. It is understood that each will have a capacity of 6,000 tons, and a speed of 20 knots.

A serious accident occurred March 19th, on the tug "Ymir," at Kootenay Landing, B.C., when R. L. Brown, chief engineer, and Hedley St. Clair, second engineer, were scalded by escaping steam. The engineers were overhauling when a valve broke; the steam rushed out and enveloped them from head to foot. Both were frightfully burned.

The Richelieu & Ontario Navigation Co. has placed under contract a sister ship to the "Toronto," to be called the "Kingston." The new boat will be 14 feet longer than the "Toronto;" the interior fittings, etc., will all be designed by Bond & Smith, architects, Toronto, whose work in the "Toronto" we have referred to at length in former issues.

Mining Matters.

Owing to the amount of space devoted to the report of the Canadian Mining Institute meeting the Editor has been obliged to hold over a large amount of mining news.

The Pembroke Observer says: J. W. Munro has secured, in bond, the Gallagher coal oil well on Allumette Island.

The deep well of the Standard Oil Co., at Inwood, Ont., is said to have proved a failure. A depth of 2,700 feet had been reached.

Sir Wm. Macdonald is about to endow the teaching faculty of mining and chemistry at McGill University, Montreal, with additional sums amounting to almost a quarter of a million dollars.

The Parry Sound district has been recently visited by Dr. N. Lehuen, St. Paul, Minn., on behalf of those interested in the Parry Sound Copper Co. After examining the Wilcox mine on Spider Lake Bay he estimated that the copper ore in this property to the depth to which the shaft has now been sunk might be valued at $9,000,000. This is one of a number of promising properties in this district, and large development is looked for.

The Hamburg Amerian Line and Norts' German Lloyd's are each having their new two mail vessels fitted with ice-making and refrigerating machinery. These steamers are now being built by the Vulcan Works, Stettin, for the mail service between Germany, Australia, and China, under contract with the Government. One of the vessels has already left on her first voyage, and a matter of interest is that in addition to the usual cold chambers and ice-making plant, two of the staterooms have been cooled. One of these was recently occupied by Sir Claude Macdonald, on his return to China, and the cool atmosphere added great additional comfort to the voyage. We believe this is the first instance of staterooms being cooled by means of refrigerating machinery, though in several cases such machinery is used for cooling dwelling houses on land. We think that there will be a wide field for this special application, and it will certainly add enormously to the comfort of passengers during a voyage through tropics.

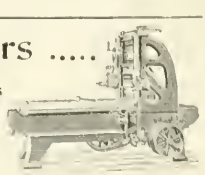
Whitcomb Planers .....

STANDARD IN AMERICA
FOR FIFTY YEARS

17 x 17 in. to 48 x 48 in.

Hand and Power Shears and Punches

WHITCOMB MFG. CO'Y,
Worcester, Mass., U.S.A.



THE CANADIAN ENGINEER INDEX

VOLUME VIII.

PAGE.

Abbott-Mitchell Iron and Steel Co.'s New Works 118
Accident Prevention Appliances 433
Accidents of the Month 80, 132
Acetylene and Carbide Notes 394
Advertising Agent, The 114
Aerial Transmission and Distribution System, Construction and Protection of 346
Africa and Canada 330
Aikenhead Hardware Co.'s Sample Room 395
Air Cell Covering, Ambler Asbestos 183, 285
Air Compressor, Synchronous Motor for 373
Air Pressure, Diagram for Calculating Compressed 334
Air Ship 150, 361
Alternating Current, Conversion of Constant Potential to Constant Current 349
Alternators, Conditions Affecting the Wave Form of 98
American Society of Municipal Improvements 440
American Steam Gauge and Valve Mnfg. Co. 292
American Stoker Co., General Engineering Co. vs. 191
Armstrong Gang Planer Tool 241
Art Metropole, Drawing Ink 104
Asbestos Air Cell Covering 183
Atlas Pipe Wrench 234
Automobile Explosion 418
Automobile Notes 12
Automobile Race, The Paris-Berlin 373

Bacteria, Sewage Purification by 23
Bank of Toronto 58
Barnes Improved Three-Wheel Pipe Cutter 181
Battery, Edison's New Storage 321, 361
Beet Sugar Industry 292
Belting Factory, Beardmore 338
Bernier's Arctic Expedition 206, 229, 237
Blower System of Ventilating and Heating 200
Boiler Tube Cleaner 186
Boilers, Government Inspection of 307
Boilers, Water Tube vs. Fire Tube 390
Boilers, Water Tube 418
Brass, Melting 339
Bricks from Sand 181
Bridge, A Novel Suspension 393
Brief but Interesting 41, 63
British Fire Prevention Committee 200
British Iron and Steel Trades 180
Brookfield Mining Co., Chlorination Plant of 203
Brown & Sharpe 120
Brown & Sharpe's Calipers and Dividers 417
Brown & Sharpe's New Tools 370
Buffalo Forge Co. Engine 185, 415
Buffalo Railway Co.'s Power Plant 283
Bulk Heads in Ocean Liners, Longitudinal 159
Burnham Automatic Feed Pump and Receiver 151
Burt Mnfg. Co. Exhaust Head 7

Cable, Armored 53
Cable, The Pacific 309
Cables, Wrought Iron Chain 54
Calipers and Dividers 417
Calyx Drill 153
Calorimeter Trials for Moisture in Steam 256
Camera, Al-Vista 242
Canada and South Africa 330
Canada Foundry Co. 13
Canada Foundry Co., Gold Medal 456
Canada, Outlook in 176
Canadian Bridge Co. 212
Canadian Copper Co. 20, 47
Canadian Engineer 163
Canadian General Electric Co. at Toronto Exhibition 395
Canadian General Electric Co.'s Mining Machinery 412

PAGE.

Canadian Mining Institute 257
Canadian Municipal Convention 456
Canadian Northern Railway 266
Cataract Tool and Optical Co., Lathe 74
Catalogues, New, 8, 44, 59, 75, 124, 151, 171, 197, 213, 267, 298, 325, 359, 433, 459
Celtic, The White Star Liner 432
Cement, Points on 416
Cement, Portland 285
Centrifugal Pumping 331
Centrifugal Rolls 8
Chambly Dam, Bursting of 162, 178
Chapman Voltage Regulator 152
Chapman Voltage Regulator at Armour & Co.'s Plant 33
Chaudiere Falls Water Power Development 307, 407, 435
Chemical Exhibition, German 115
Chemistry of Paper Making 226
Chicoutimi Dam Failure, The 310
Chimney Construction 113
Chimney, Highest in the World 203
Chimney, Toronto's Tall 144
Chimney vs. Fan 320
Chlorination Plant of Brookfield Mining Co. 203
Chuck, The Lathe 394
Chucks, Errington Automatic Reverse Tapping 56
Civil Engineers, Canadian Society of 15, 93, 117, 144, 162, 185, 207
Clergue, F. H., and Industries of Sault Ste. Marie 210
Coal Mining in the 19th Century 363
Colwell Mnfg. Co.'s, Telephone 284
Cobra, Speed and Coal Consumption of the Turbine of the 120
Concentration of Ores, Magnetic 235
Concrete Walks, Tools for 351
Concrete Works, Etc., Masonry Dams and Retaining Walls in General 219, 233
Conduit, Greenfield Flexible Metallic 5
Conduit Development of Interior 15
Contracts, Government 61
Copper Refining, Electrolytic 10
Correspondence, Answers to 202
Cramp Ontario Steel Co. 43
Cramp, Ontario Steel Co.'s Works at Collingwood 204
Crane Co. at Paris Exhibition 198
Culverts, Cement Concrete 9
Culverts, Drain Pipe for Railway 42
Dam Failure, The Chicoutimi 310
Dams, Masonry, and Retaining Walls in General Concrete Works, Etc. 219, 233
D'Este & Co., Julian, Pressure Regulator 234
Detroit Lubricator Co., Pendry Throttle Valve 160
Dials on Machine Tools, Graduated 265
Diamond Expansion Bolt and Shield 374
Diamond Saw and Stamping Works 11
Dividers and Calipers 417
Dominion Cotton Mills Co., Electric Power Equipment for 385
Dominion Iron and Steel Co. 433
Downer Pattern Works 393
Drainage of Houses and Towns, The Sanitary 457
Draining, Improvements in Private 50, 80
Drill, Calyx 153
Drill, Electrically Driven 405
Drill, Holders, Simplex 112
Drysdale, D. Little Giant Jack Screws 97
Dynamo, Reversing a 48
Dynamo and Storage Battery in Telegraph offices 132
Edison's New Storage Battery 321, 361
Education, Science in 199
Electric Flashes 20, 38, 64, 83, 110, 140, 166, 194, 216, 247, 269, 294, 318, 352, 380, 398, 425, 450
Electric Illuminations for Royal Visit 441
Electric Light Association, National 325
Electric Power to Toronto 291
Electric Railways of Canada 287
Electric Railway System of Quebec 89
Electric Railway, German High Speed 446, 449

PAGE.

Electric Transmission Plants in Canada and the United States 383
Electrical Association, Canadian, Supplement, August, 1900, 104, 322, 341
Electrical Developments of Canada 249, 273, 301, 307, 385, 407, 435
Electrical Fire Damp Indicator 400
Electrical Mining Machinery 412
Electrical Standards, Dominion 335
Electrically Driven Drill 405
Electricity, Young Men in 329
Elevator Construction 375
Employer and Employee 392
Engine, Buffalo Centre Crank 185
Engine, Combined Water Wheel and Steam 360
Engine, Small Vertical of B. F. Sturtevant & Co. 202
Engines in Western Australia, Canadian 34
Engines, The New "Rival" in Small 395
Engineer, The Master Spirit of the Age 55, 133
Engineers and Surveyors 320
Engineers' Association, Marine 187
Engineers, Canadian Association of Stationary 8, 60, 79, 94, 186, 340, 391, 430, 445
Engineers, Canadian Association of Stationary, Annual Dinner 142
Engineers' Club of Toronto 60, 161, 186, 212, 432
Engineers, Ontario Association of 42, 324
Engineers, Canadian Society of Civil 15, 93, 117, 144, 162, 185, 207
Engineering Congress, International 410
Engineering, Construction Methods in Civil 288
Engineering Ethics 162, 254, 283
Engineering Profession, Success in the 222
Errington Auto-Reverse Tapping Chuck 50
Exhibition, Toronto Industrial 176, 309
Exploring New Ontario 34, 60
Fairbanks Asbestos Air Cell Covering 183, 285
Fan, Chimney vs. 320
Fan, Electric Propeller Ventilating 59
Fender Question, The Street Car 414
Filter Press in Reduction Works 57
Fire Damp Indicator 400
Fire Equipment, Lachine Rapids Hydraulic and Land Co.'s 70
Fire, Hull-Ottawa 7
Fire Prevention Committee, British 200
Fires of the Month 7, 34, 80, 132, 383, 400, 430
Flanges, Standardization of Extra Heavy 440
Fleming, Sir Sandford and Pacific Cable 309
Fleming & Co., W. A., Cold Water Paint 417
Frasch Process of Nickel Extraction 114
Fresh Air Fund 351
Fuel and Power of Canada 322
Fuel, Pulverized 377
Gas Engine Conditions, Necessary 16
Gas Engine Dimensions 33
Gas Engines, Progress of 411
Gas from Wood, Riche's Method of Producing 74
Gas, The Mond 400
Gate for Approaches to Swing Bridges 244
Gate for Interlocking Mechanically Operated Draw Bridge 290
Gear Cutting Machine, Whiton's 183
Gearing, Noiseless 180
General Engineering Co. vs. American Stoker Co. 101
Generating Set, Direct Connected 415
Geological Survey Department Report 47
Glasgow Exhibition 233
Gold Milling, Free 130
Goldie & McCulloch "Model" Gas Engine 33
Government, Extravagance of 138
Gourlay, Winter & Leeming Bell Metal Tone Pulsating Bridge 400
Greenfield Flexible Metallic Conduit 5

PAGE.

Greenfield Flexible Steel Armored Cable 53
Guns and Rifles, Stevens New 272
Hack Saw Test 11
Hamilton Steel and Iron Co.'s New Steel Plant 40
Harbor, Toronto 52
Hays, Chas. M., and the Grand Trunk 152
Head Lights in Locomotives, Electric 79
Heat, Wasted 392B
Heater, Otis Feed Water 182
Heating, Artificial 69, 91
Heating and Ventilation 48, 87, 121
Heating and Ventilation, Blower System of 206
Heating a Public Building 319
Heating, Hot Water 79
Hot Water Circulation 1, 25
Huronic, The 412
Hydraulic Presses 319
Ice-Breaking Steamers on the St. Lawrence 209
I. C. R. Ferry Steamer, The New 432
Imperial Trade Notes 11, 43, 60, 123, 154, 171, 181, 232, 383
Incorporations, New 340, 430
Indicator, Electrical Fire-Damp 400
Industrial Notes, 17, 36, 62, 81, 100, 125, 145, 165, 192, 214, 245, 268, 293, 315, 351, 377, 396, 422, 447
Industrial Primacy of the 20th Century 225
Injector, New Lunkenheimer Standard 202
Inks, New Drawing 104
International Engineering Congress.. 410
Interprovincial Bridge at Ottawa 144
Iron and Steel Trades, British 180
Iron and Steel, The Effect of Time and Temperature on 413
Iron Ore Deposits of Bilbao 367
Iron, Production of Canadian Pig ... 116
Jack & Robertson, Greenfield Metallic Flexible Conduit 5
Jones-Underfeed Stoker 184
Kerr Engine Co., Disc Valves 324
Keystone Boring Tool Holder 283
Keystone Combination Roller Pipe Vise 374
Kingston School of Mining 131, 161
Lachine Rapids Hydraulic and Land Co.'s Fire Equipment 79
Lachine Rapids Hydraulic and Land Co.'s Switchboard Equipment 311
Lachine Rapids Power Plant 301
Lake Erie, Regulation of the Level of 229
Lamps, Arc 100
Lamplough & McNaughton, White Metal 120
Lathe, New Precision 74
Laurie Engine Co. New "Rival" Engine 395
Lead and Zinc Industry of Southwest Missouri 87, 117
Literary Notes 11, 43, 57, 78, 124, 143, 212, 297, 326, 359, 431
Locomotives, Electric Head Lights on 79
Lubricating, A High Speed Engine with Water 283
Lubricator, Improved Gas Engine.. 324
Lumsden & Co., J., Simplex Drill Holders 112
Lunkenheimer Extension 182
Lunkenheimer Improved Gas Engine Lubricator 324
Lunkenheimer New Pressure Oil Cup 244
Lunkenheimer Standard Injector ... 202
Macadam for Streets, Tar 176
Manual Training in Canada 135
Manzel Automatic Oil Pump 142
Marine Engineer's Association 187
Marine News, 22, 39, 64, 86, 111, 130, 148, 170, 190, 214, 240, 271, 297, 318, 381, 397, 399, 427, 451
McCormick Turbines in the Comstock Mines 414
McGill University, Applied Science Graduates of 16
Metal Imports from Great Britain... 17, 43, 171, 197, 238, 292, 459
Metal, White 120
Metals, An Absolute Determination of the Thermal Conductivity of 2, 31
Metric System 227, 282, 325
Metropolitan Railway, Toronto 29
Mica Boiler Covering Co., Ltd 72

PAGE.

Midland Smelter, The New 188
Milling, Free Gold 139
Mineral and Metal Production of the United States 72
Mineral Output of British Columbia 81
Mineral Production of Canada in 1899 77
Miner's Inch, The 155, 184
Mines of British Columbia 392D
Mines of British Columbia, North Star and Nickel Plate 261
Mines, Report of Ontario 362
Mining Institute, Canadian 257
Mining in the 19th Century, Coal.. 363
Mining Matters, 19, 39, 66, 84, 111, 129, 149, 168, 195, 218, 272, 296, 316, 354, 379, 397, 428, 452
Mining Machinery, Electrical 412
Miscellaneous Notes ..327, 382, 432, 455
Mond Gas 400
Motor for Air Compressor, Synchronous 373
Motors, Induction 100
Municipal Convention, Canadian..... 456
National Electric Light Association. 325
New Jersey Foundry and Machine Co., Diamond Expansion Bolt and Shield 374
New Process Raw Hide Co., Noiseless Gearing 180
Nickel, A New Chance for 330
Nickel Extraction, The Frasch Process of 114
North Bros "Yankee" Ratchet Screw Driver 370
North Star Mine and Nickel Plate Mine of British Columbia 261
Oil Cup, Pressure 244
Oil Cup, Manzel Automatic 142
Oil, Fuel in Iron Works, Crude.... 332
Oil Stones, Trophy of 206
Ontario, Exploring New 34, 60
Ontario Land Surveyors Ass'n.... 14, 238
Ores, Magnetic Concentration of ... 235
Orillia Power Plant 56
Otis Feed Water Heater 182
Paint, Cold Water 417
Paper Making, The Chemistry of... 226
Pan-American Exhibition, Machinery Hall 330
Pan-American Exhibition, A Syndicate Exhibit at 414
Parson's Steam Turbine Reversing Mechanism 242
Patent Act, Proposed Amendments to 45
Patents, Recent Canadian 22
Peat Fuel Manufacture 115
Pendry, Throttle Valve 160
Personal..21, 40, 65, 85, 112, 130, 149, 196, 219, 240, 271, 295, 326, 352, 399, 429, 454
Perrin, Wm. R., Filter Press 57
Perrin, Wm. R., Hydraulic Presses. 319
Petroleum in Gaspe 52
Pipe Cutter, Barnes Improved Three-Wheel 181
Pipe for Railway Culverts, Drain.... 42
Pipe Wrench, An Atlas 234
Pipes, Dimensions of Wrought Iron Welded 43
Piper Railway Supply Co., N. L. Gate for Swing Bridges 244
Pike Mnfg. Co. Trophy of Oil Stones 200
Plumbers and Steamfitters, The National Association of 339
Power and Fuel of Canada 322
Power Factor as Affecting Operation and Investment 100
Power Plant, Orillia 56
Power Plant of Buffalo Railway Co. 283
Practical Man 43, 54
Prentiss Vise Co. 75
Presses, Filter 57
Presses, Hydraulic 319
Pressure Regulator, An Air Spring.. 234
Propeller Shafts, Corrosion and Failure of 44
Pump and Receiver, Burnham Automatic Feed 151
Pumping, Centrifugal 331
Quebec Electric Railway System .. 89
Queen Victoria 200
Rails Badly made, Heavy 33
Railway, Canadian Northern 266
Railway Curves A Question in 236

PAGE.

Railway German High Speed Electric 419, 446
Railway Matters, 22, 40, 64, 86, 111, 127, 168, 193, 217, 245, 270, 295, 317, 353, 381, 398, 428, 453
Railway Statistics, Canadian 241
Railways of Canada, Electric 287
Refrigeration, Mechanical 172
Regulator, An Air Spring Pressure. 234
Regulator, Chapman Voltage.....33, 152
Riche's Method of Producing Gas from Wood 74
Richelieu & Ontario Navigation Co. 238
Road Building in Canada 137
Robb Engineering Co. 160
Robb Engineering Co., Engines in Western Australia 34
Royal Train 443
Royal Trolley Car, The First 445
Royal Visit, Illuminations for..... 441
Royal Visit Souvenir Time Table.... 440
Sand Bricks, Another Process for.. 213
Sand of the St. Lawrence Shore, Magnetic Iron 313
Sault Ste. Marie, Industries 210
Science in Education 199
Science, School of Practical 42
Scottish King, The Floating of the.. 154
Screw Driver, "Yankee" Ratchet..... 370
Screws, Little Giant 97
Sewage, Chemical and Bacterial Treatment of 456
Sewage Disposal..265, 323, 354, 370, 401
Sewage Purification by Bacteria 23
Shafts, Corrosion and Failure of Propeller 44
Shears, Alligator 80
Shawinigan Water & Power Co.'s Plant, Construction of 249, 273
Smart-Eby Machine Co. Alligator Shears 80
Smelter, The New Midland 188
Sprague Electric Co., Greenfield Flexible Metallic Conduit 5
Sprague Electric Co., Armored Cable 53
Standard Oil Co. 54
Stationary Engineers, Canadian Association of, 8, 60, 79, 94, 186, 340, 391, 430, 445
Stationary Engineers' Annual Dinner, Canadian Association of 142
Stationary Engineers, Ontario Association of 42, 324
Standards, Dominion Electrical 335
Standardization of Extra Heavy Flanges 440
Standardizing Tests of Cast Iron.... 337
Starrett Co., L. S., Tool Supply House 75
Steam, Calorimeter Trials for Moisture in 256
Steam Engine and Water Wheel Combined 360
Steam, Superheated 332
Steamers on the St. Lawrence, Ice-Breaking 209
Steamfitters, National Association of Plumbers and 339
Steel, Canada's 230
Steel Plant of Hamilton, Steel and Iron Co. 46
Steel Works at Collingwood 204
Steel and Iron, Effect of Time and Temperature on the strength of ... 413
Stevens Arms and Tool Co. 340
Stevens Guns and Rifles 272
Stoker, Jones-Underfeed 184
Storage Battery and Dynamo in Telegraph Offices 132
Storage, Cold 76
Strikes 357
Sturtevant Co., B. F., Electric Propeller Ventilating Fan 59
Sturtevant Mill Co., Centrifugal Rolls 8
Surveyors, Ontario Association of Land 14, 238 320
Switchboard Equipment, Lachine Rapids Hydraulic and Land Co 311
Tar Macadam for Streets 176
Telegraphy, Wireless 155
Telephone Problem in Canada 438
Telephone, The Modern 284
Tests of Cast Iron, Standardizing... 337
Thompson & Co., Richard, Boiler Tube Cleaner 186

PAGE.

Tree-Wire Distribution, Balancing of 334
Tin, Phosphor 393
Tool, Armstrong Gang Planer 241
Tool Holder, Boring 283
Tools, Brown & Sharpe 370
Tools for Concrete Walks 351
Tools, Graduated Dials on Machine.. 265
Tools in Workshop Practice, Influence of Portable 333
Toronto Industrial Exhibition ...170, 309
Toronto Industrial Exhibition, Canadian General Electric Co. at..... 395
Transmission and Distribution System, Construction and Protection of Aerial 346
Transmission Lines, Long Distance. 383
Tube Cleaner, Boiler 186
Tubing, Flexible Metallic 7
Turbine Reversing Mechanism, Parson's Steam 242
Turbines in the Comstock Mines, McCormick 414
United Flexible Metallic Tubing Co. 7
Valve, A New Throttle 160
Valves, Copper Alloy Disc 324
Vancouver Engineering Works, Ltd. 358
Ventilating Fan 59
Ventilation and Heating 48, 87, 121
Ventilation and Heating, Blower System of 206
Vise, Keystone Combination Roller Pipe 374
Vokes Hardware Co., Tools for Concrete Walks 351
Water as a Stored Power, Superheated 67
Water Pipes, Friction in 243
Water Power Co.'s Plant, Construction of Shawinigan 249, 273
Water Power Development at Milleroches 279
Water Power Development at Chaudiere Falls 307
Water Tube Boilers 418
Water Wheel and Steam Engine Combined 360
Waterworks, Accident to the Winnipeg 163
Waterworks, The 177
White Star Liner "Celtic" 432
Whiton's Improved Gear Cutting Machine 183
Williams & Co., A. R., Flexible Metallic Tubing 7
Williams & Co., J. H..... 108
Wire Nail Industry 54
Wireless Telegraphy 155
Wrench, An Atlas Pipe 234
Yukon River Improvements 418
Zeppelin's Air Ship 150
Zinc and Lead Industry of Southwest Missouri 87, 117

BIOGRAPHICAL SKETCHES.

Barnes, Howard T. 160
Barlow, John R. 182
Bernier, J. E. 237
Chausse, Joseph Alcide 60
Fleming, Sandford 310,
Gill, L. W. 161
Goodwin, W. L. 161
Girouard, Lieut.-Col. 191
Janin, Geo. A. F. R. 384
Kennedy, M. J. 191
Kennedy, Walter ..... 2[illegible]
Marien L. J. 54
Reesor, B. F. 377
Reeve, George B. 159
Robertson, James 187
Walkem, Geo. A. 359
Weller, J. L. 207

PORTRAITS.

PAGE.

Barlow, John R. 182
Barnes, Howard T. 160
Bernier, J. E. 237
Canadian Association of Stationary Engineers 94, 392A
Canadian Electrical Association 342
Cary, E. E. 108
Chausse, Joseph Alcide 60
Davidson, George W. 90
Dickson, James 14
Dickson, J. M. 96
Fergie, Charles 201
Fleming, Sandford 310
Galbraith, Prof. 187
Gill, L. W. 161
Girouard, Lieut.-Col. 191
Goodwin, W. L. 161
Hering, Rudolph 15
Keating, E. H. 210
Kennedy, M. J. 191
Kennedy, Walter 205
Logan, R. S. 272
Queen Victoria 201
Reeve, Geo. B. 159
Reesor, B. F. 377
Robertson, James 187
Ross, Geo. 14
Rhys-Roberts, E. A. 15
Walkem, Geo. A. 359
Weller, J. L. 207
Webb, Wm. J. 338
Zeppelin, Count 150

CORRESPONDENCE.

Atterbury, T. W., "Another Process of Sand Bricks." 213
Baillairge, Chas., "Instructiveness of Failure." 178, 243
Baillairge, Chas., "The Floating of the Scottish King." 154
Baillairge, Chas., "Longitudinal Bulk Heads in Ocean Liners." 159
Barrow, Ernest G., "Chemical and Bacterial Treatment of Sewage."... 456
Beauchemin, L. A., "Best Foundations for a building ?" 202
"C." Montreal, "Reversing a Dynamo." 79
"C. G," Durham, "Hot Water Heating" 48
Chipman, Willis, "Engineering Ethics" 254
Flint, Leonard R., "Water Tube Boilers." 418
Forward, E. A., "Canadian Engineer" 163
Frood, T., "The Fuel and Power of Canada." 322
Frood, T., "Pulverized Steel." 377
King, Robert W., "Engineering Ethics" 162, 254
King, Robt. W., "The Miner's Inch." 184
Lasche, O., "German High Speed Electric Railway." 419, 446
Perry, William, "Centrifugal Pumping." 331
Phelps, Oliver A., "The Lathe Chuck" 394
Ronald, J. D., "Canadian Engineer." 163
Scane, Thomas, "A Question on Railway Curves." 236
Still, George S., "The Edison Storage Battery Discounted." 361
Williamson, C., "Friction in Water Pipes." 243

CONTRIBUTORS OF SIGNED ARTICLES.

Adams, Frank D., "Notes on the Iron Ore Deposits of Bilbao, Northern Spain" 367
Andrewes, E., "Magnetic Concentration of Ores" 235
Archibald, E. M., "Conditions Affecting the Wave Form of Alternators" 98
Baillairge, Chas., "The Engineer, the Master Spirit of the Age" 55, 133

PAGE.

Baillairge, Chas., "Masonry Dams and Retaining Walls in General, Concrete Works, Etc." 219, 233
Baillairge, Chas., "The Chicoutimi Dam Failure" 310
Bayard, A. W., "Chimney vs. Fan." 320
Blair, D. E., "The Quebec Electric Railway System." 89
Blakemore, W., "Coal Mining in the 19th Century." 303
Butler, M. J., "Success in the Engineering Profession." 222
Camp, W. J., "The Use of the Dynamo and Storage Battery in Telegraph Offices." 132
Cooper, Ernest S., "Necessary Gas Engine Conditions." 16
Denis, L., "Balancing a Three Wire Alternating Secondary System 334
Dixon, John M., "Employer and Employee" 392C
Draper, F. W., "Lead and Zinc Industry of Southwest Missouri."... 87, 117
Duncan, G. R., "An Absolute Determination of the Thermal Conductivity of Metals." 2, 31
Edwards, W. Muir, "Free Gold Milling." 139
Farncomb, F. W., "The Regulation of the Level of Lake Erie 229
Gautier, Emile, "The German Chemical Exhibition." 115
Herdt, L. A., "Conditions Affecting the Wave Form of Alternators."... 98
King, R. W., "Hot Water Circulation." 1, 25
King, R. W., "Superheated Water as a Stored Power, and a Conductor of Heat and Power." 67
King, R. W., "Calorimeter Trials for Moisture in Steam." 256
King, R. W., "Manual Training in Canada." 135
Lea, R. S., "Sewage Disposal." 265, 323, 354, 370, 401
Leonard, F. H., jr., "Power Factor as Affecting Operation and Investment, with Special Reference to Induction Motors and Enclosed Arc Lamps." 100
Morse, C. M., "The Calyx Drill."... 153
Obalski, J., "Magnetic Iron Sand of the St. Lawrence Shore." 313
Owens, R. B., "Conversion from Constant Alternating Potential to Constant Alternating Current." 349
Philip, E. J., "Chimney Construction" 113
Ritchie, jr., J. Norman, "Chlorination Plant of Brookfield Mining Co."... 203
Skinner, Frank W., "Construction Methods in Civil Engineering."... 288
Smith, Clifford C., "New Steel Plant of Hamilton Steel and Iron Co." 46
Snow, W. B., "Ventilation and Heating." 48, 87, 121
Thornton, K. B., "Notes on the Construction and Protection of Aerial Transmission and Distribution System." 346
Turnbull, J. M., "The North Star Mine and Nickel-Plate Mine of British Columbia 261
Tyrrell, H. G., "Interlocking Mechanically Operated Draw-Bridge."..... 269
Tyrrell, H. G., "The Sanitary Drainage of Houses and Towns." 457
Waddell, John, "Chemistry of Paper Making." 226
Watson, W. M., "Sewage Purification by Bacteria." 23
Watson, W. M., "Improvements in Private Draining." 50
Watson, W. M., "Artificial Heating." 69,91
White F. H., "Mechanical Refrigeration." 172
Wickens, A. M., "Wasted Heat" 302B

The Canadian Engineer

VOL. VIII.—No. 2. TORONTO AND MONTREAL, JUNE, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE
CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL.

TRAVELING REPRESENTATIVE: A. W. SMITH.
PHILADELPHIA AGENT: H. E. BURNETTE, 2036 N. 13th Street.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

Brief but Interesting	41	Metropolitan Ry. Co., The	29
Canadian Copper Co., The	29	Mining Matters	39
Canadian Engines in Western Australia	34	New Ontario, Exploring	34
Catalogues, New	44	Personal	40
Cramp Ontario Steel Co., Ltd., The	43	Practical Man, The	43
Corrosion and Failure of Propeller Shafts	44	Rails, Heavy, Badly Made	33
Electric Flashes	38	Railway Culverts, Drain Pipe for	42
Fires of the Month	34	Railway Matters	40
Gas Engine Dimensions	33	Sewage Purification by Bacteria	23
Hot Water Circulation	25	School of Practical Science	42
Imperial Trade Notes	43	Stationary Engineers, Ontario Association of	42
Industrial Notes	36	Thermal Coductivity of Metals, An Absolute Determination of	31
Literary Notes	41	Voltage Regulators, The Chapman Automematic	33
Metal Imports from Great Britain	43		

For THE CANADIAN ENGINEER.

SEWAGE PURIFICATION BY BACTERIA.

BY W. M. WATSON.

Purifying sewage by bacteria culture is fast growing beyond the experimental stage, and has evidently come to stay. The method is both sensible and natural, and is simply assisting the bacteria that the foul fluid contains to remove the filth from the water. We have shown in previous articles that we can help the bacteria to clean the sewage by fixing the plumbing, so that plenty of air is discharged into the sewers along with the sewage, and by constructing our sewers in a way that the flow is rapid, and that every inch of the drains has a thorough circulation of air through it. By doing so, the process of bacterial sewage purification commences immediately the sewage enters the waste water pipes.

For over a century, thinking men have been trying to find out nature's way of cleansing filthy fluids, but poor success attended their labors until a few years ago, when the fact was made plain that there were creatures that could not be numbered or seen by the naked eye, whose duty it was to purify and clean objectionable matters. The varieties of these minute animals, named bacteria, are numerous and interesting; so are their appointed duties; some encourage and assist in the growth of life and vegetation, while other classes destroy such life and foster putrefaction.

The waters and air are full of germs. Their habits do not materially differ from other animals, or insects that can easily be seen by the unassisted eye, for we are told that some bacteria can only live where air cannot penetrate, others can only live by securing a regular supply of air or oxygen, and one division feed on the flesh of another division; so that a striving for the mastery is always going on in the world of microbes. This fact gives man the advantage of being able to use these invincible bacteria to keep things sweet, clean and wholesome, by constructing machines that will encourage the friendly bacteria to lodge, to lay wait, catch and destroy, that class of bacteria that injures our health and fouls our waters. When clean water is turned to sewage, the process means that dead and living microbe substances, of an objectionable kind, have taken possession of the water and compelled the friendly ones to be on the defensive.

Up to the present date, only a few experimental plants have been constructed to purify sewage on strictly bacterial lines, while hundreds of works have been built to clean sewage by sieving, by using precipitants to separate the solids from the liquids, and by passing sewage through land. Some of these methods have appeared to be successful for a period, until the land got sewage sick, and the soil was unable to receive atmospheric air sufficient to keep the cleansing bacteria active when the sewage farm became a putrid, stinking mass and the people's money had been wasted.

About two years ago the Imperial Government appointed a committee to investigate and test the several improvements made in the art of purifying sewage, and carefully study their details, with a view to securing some safe and reliable system or systems that could be recommended, and would give the taxpayers proper value for the money they expended, besides insuring the rivers from being further contaminated with sewage works effluents, that are often as injurious to the fresh water streams as the raw sewage would be if discharged into the rivers unsieved and untreated. I am informed that the Royal Commission has about completed the testing and experimental work, and is, I believe, now preparing its report, which will be of very great value to every municipality in the world. We cannot say what system the Commission will advise the Imperial Government to adopt and recommend for the use of the British public, but I have received information from a gentleman closely identified with the commissioners and government sanitary works, and what he tells me appears to point to the bacterial system being recommended. This is a system which takes the raw sewage and passes it through an artificial filter, the contents of which are sown with live, friendly bacteria, which attract every minute atom of dirty fluid as it passes through the filter, and eat up, or otherwise totally destroy all the filth and poisonous ingredients the sewage contains without the aid of

chemicals or precipitants of any kind, and by so doing, abolish the sludge difficulty, because when the germs have done their duty, there are no solids left to remove. The printed reports and description my friend was kind enough to send me, are long and exhaustive, and would be difficult to understand, for readers that have not fully studied the subject of purifying sewage by microbes. On this ground I propose to condense this report to about one per cent., at the same time show how the bacterial system is operated, and how foul fluids are purified by that process.

It is probable that the Commissioners will recommend more than one system, for the sewage discharged from breweries, galvanizing works, sugar and grease factories, soap works, and dye-houses, all require a different method of treatment, but can all be treated by bacteria of one or other of the variety of classes. Different classes need handling by different processes, but there are three systems that purify sewage by bacteria, that appear able to treat any kind of sewage sent to them.

Adney's system, fully described on page 346 of the Canadian Engineer, dated April, 1898, uses a precipitant, and also adds nitrate of soda to the sewage to answer in place of aerating. Cameron uses a septic tank which the sewage must pass through and remain in for 24 hours, to allow the class of anaerobic bacteria to work on the dirty fluid, compelling fermentation, and breaking up and disintegrating the particles, and letting free the foul gases. The sewage is then aerated, which promptly kills the anaerobic germs, and the fluid passes into the bacteria filter to secure purification.

The third system is the one I propose to describe, as it has not been explained before in this paper, and the inventor claims that he can handle any kind of sewage (which I doubt); but the process may answer well, where the sewage is 80 per cent. domestic. The method is used at Crossness, treating the London, Eng., sewage, and a few smaller places. Bacteria are the only instruments used, and they are delicate creatures to handle; they easily succumb if they are overfed, or run short of air; and if the discharge from the filters is too rapid, they are washed away, and pass out with the effluent. The works and management of this kind of sewage purification should cost much less than works that have been erected before, with the intention of purifying sewage, but experience proves that, so far, the experimental plants are far more costly. On account of bacteria requiring regular and strict rules of dieting and aeration, and that sewage often varies two or more times each day, requiring more or less time to be given to the microbes to perform the work, a point which the green attendants cannot understand, causes the bacteria culture that has been carefully sown in the filters to soon become disabled, and scientific experts have to be called in to resow the filtrate with bacteria, and their charges for this work have been very extravagant; this makes the ratepayers shy of adopting a process that requires professionals to work it satisfactorily. This difficulty cannot last long, for to an intelligent person it must appear simple enough, and I am sure the workings of the bacteria culture sewage purification plants are as easy to learn as the majority of other plants, and if the system becomes common, there will be plenty of working men who will handle such works with as much, and probably more, efficiency than the scientific experts have been able to do thus far; when that time arrives, then bacteria-cultured filters will purify sewage cheaper than any other system. The sewage treated successfully at Crossness is a mixture of domestic and trade sewage, but it is not so difficult to treat as the Birmingham or Burton trade sewage.

It has been found that coke is best suited to form the filters at Crossness, probably because it leaves the largest space for fluids; and also that deep tanks will purify sewage equally as well as shallow ones, and do proportionally more work. The system of aerating the filtrates by giving them an alternate dose of sewage and air is adopted. The tanks are filled to within about one inch of the cokes' surface with raw sewage, which stands quiescent for about three hours to allow the friendly bacteria time to attack every particle of the sewage and extract the objectionable matter, after which the tank is slowly emptied, and as the fluid passes out of the coke the air is drawn in to fill the spaces. The filter is allowed to stand empty for about eight hours to allow time for the effluent to dribble out of the cells of the coke, and allow atmospheric air to pass in. It seems to me that the filters might be aerated both quicker and better by using the late George Waring's method of blowing air upwards through the coke filtrate with a fan, because eight hours would not then be wasted each filling to aerate the coke, and about two-thirds more work might be done by the same filter space; besides the face and air cells of the pieces of coke would secure a better cleaning. See description of Waring's system in March issue of the Canadian Engineer, page, 318, for 1899.

The amount of work that can be done by a sewage purification filter is estimated by the number of cubic feet of coke the filter contains; a good clean filter will hold over three gallons of sewage to each cubic foot of coke. Filters holding less in depth of coke than 3½ feet do not purify the sewage satisfactorily. At the Crossness works they have constructed filters holding a depth of 13 feet of coke; they appear to work all right, and there appears no reason why space might not be still more economized and filters made as deep as the seat and position of the sewage works will permit. Filter tanks may be constructed of brick or stone, concrete, or any material that cannot absorb moisture. There need be no limit to their superficial size, but one about 50 square yards can be handled best. At the bottom of each filter tank there is a series of suitable tile pipes spread all over, containing many small holes together with open joints, they are arranged somewhat similar to the trunk and branches of a large tree, the trunk end passes through the wall to a receiving culvert, having a valve attached so that the sewage can either be held in, or drawn from the tank, when necessary. Over this net work of pipes, selected and well cleaned coke, of a certain size throughout, is evenly and closely laid, up to the required depth, the surface being finished perfectly level. This done, the filter is ready to be sown with bacteria, which means getting all the air cells of the coke tenanted with families of bacteria germs; this usually takes one month, or about 50 fillings of sewage; the filters being filled, emptied and

aerated exactly the same as they are when working effectively; this assists the friendly bacteria to breed and multiply until their numbers are enough to destroy all injurious germs the foul sewage may contain, after which the effluent from the filters will be clean and fairly purified. The filters will, after being brought to this state of efficiency, continue so just so long as they secure proper and sufficient aeration or oxygen. To prevent the air cells of the coke getting choked with fibre, straw, wood, or any other indissoluble material, the sewage should be carefully sieved before it is allowed to pass on into the filters.

When these instructions are carried into effect, the effluent drawn from the filter is stated, by Messrs. Clowes and Houston, in their second report to the London County Council last year, to be better purified than the effluent discharged from any other sewage works that do not take advantage of the bacteria purification. Then if the effluent from the first filter is passed though a second one, it is brought to a purity of over 92 per cent., and the effluent that is discharged into the river is so well stocked with the cleansing germs that it continues its purification process until finally complete, which is said to be exactly opposite to the effluents discharged by works that only sieve the sewage, and use precipitants, because it is found that such effluents set up decomposition.

I might here say that the purified effluent from a sewage works using bacteria culture as a medium of purification is valuable for washing wool and dyeing soft goods; besides many other purposes, it is equal to spa water for business purposes and gardens. This system is not suitable for private hotels similar to the summer hotel at Pentanguishene, because before the sewage is turned on to a bacteria filter, it must be liquefied. The liquefaction process is done in the sewers themselves, in towns and cities, but it cannot be done where it only takes five minutes for the solids to travel from the water closet to the outfall, therefore the septic tank system that compels the sewage to remain one whole day in a tank, prior to passing to the filter, is the most suitable for such places to adopt. Should sewage be passed onto the filter unliquefied, the bacteria would be choked about the first dose, and the filter would be sick, and ruined, very similar to the artificial filter bed at Penetanguishene in 1897 and 1898. When a bacteria filter gets sick, and refuses to purify sewage, there is but one treatment to get it healthy, that is, to let it remain empty and receive plenty of aeration for a space of a week or a month, according to the seriousness of the damage done. If Waring's system of forcing air through the coke is used, probably one day might answer. Freely using a garden rake to loosen up the surface of the coke is also beneficial.

Sewage works cannot be worked on stereotyped principles, especially in manufacturing towns, because the quality of the sewage often changes several times daily. When it is very dense and foul, then the bacteria germs need more time to digest the matter, and probably double the amount of time for aeration. Where coke cannot be easily and cheaply bought, there is no reason why coal, slag, domestic cinders, stone, chips, burnt clay, or other substances that can resist chemicals and moisture may not be used; coal has properties far in advance of coke for filtering purposes, but a filter charged with coal would only hold about half the liquid sewage that a coke filter will hold, which gives the latter a preference, but all this is fully explained in previous articles in the Canadian Engineer.

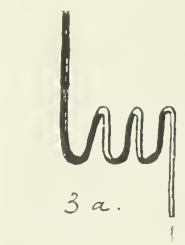
In summing up my remarks on this bacteria culture system of purifying sewage, I may say that it will be the cheapest and most efficient way of treating sewage yet invented, when properly worked on business principles, and a gigantic failure if not so operated. A very limited area of land will do for the plants, steam boilers or machinery will seldom be required, because if ten feet in depth between the level of the sewer invert and the surface of the water into which the effluent will have to be discharged, can be got, then the works will work all right by gravitation. There is no sludge to handle or get rid of, because the germs turn it all into gases or clear water. There are no costly precipitants to buy or mix by costly machinery; and we are insured to have an effluent that will not putrify and set up decomposition when mixed with fresh water. These are points worth noting, because in the past vast sums of money have been expended in sewage works, that have discharged a clarified effluent saturated with costly precipitants into the water courses, that have afterwards turned putrid, and done more damage to the body of fresh water into which it has become incorporated than the raw sewage would have done if the cost of treatment had been avoided.

HOT WATER CIRCULATION.*

BY R. W. KING, MECH. ENG., MEM. CAN. SOC. C.E.

(Continued from last issue).

In regard to the laying of the connecting pipes, they must be quite free from air-traps, or places where air can gather. To force water through a coil such as represented by Fig.3, it requires a head equal to the



3a. FIG. 3.

combined height of all the bends, with three bends one foot high it will require a head of over three feet to force water through, air being allowed to remain or gather in the coil. For this reason, perpendicular kinks or bends in horizontal flow or return pipes to a radiator, whose height would equal the diameter only of the pipe, would almost, if not quite, close the circulation to that radiator; since this imperfection would be noted, the chief danger lies in those bends or kinks that may close a radiator off by only a small per cent. of its efficiency.

*A paper read before the Toronto Engineers' Club.

A lack of heat in the room will likely be blamed by the fitter on anything but his own bad workmanship or design. Where bends or drops in a pipe are unavoidable, the air traps thus caused can be relieved and the pipe restored to its full circulating value by the running of air vents to above the water level or connecting to expansion tank, etc., etc., as the requirement of the particular case may demand.

This same principle applies to the circulation or flow of water in other pipes, such, for instance, as that unfortunate piece of engineering illustrated in the laying of the Toronto water works pipe across the bay, which, owing to the irregular shape of the bottom of the bay, is not likely to be laid perpendicularly in line. There is another difficulty here, namely, that every entrapped cubic foot of air, when under water, has a lifting power of about 62½ lbs. Now, by relieving these traps or upper bends (which must necessarily be in the shallower water), by some efficient device or plan, so no air of any serious extent can collect or gather in the pipe, the flow of the pipe will be restored to its normal capacity (which the mere holding of the pipe down by a weight of cribbing, stone or sand will not accomplish), and the desire of an iron pipe to tear itself apart in order to take a swim on the surface of the water entirely overcome.

In further support of this theory allow me to point out: First, that air or gases did accumulate in the waterworks pipe, since by no other possibility could an iron pipe float, and the fact of now holding it down by cribbing, etc., indicates that further accumulations of air are expected to reoccur and in fact probably already exist. Secondly, that where a pipe contains air it cannot contain water to its full capacity, and as previously noted, it matters not where the impediment to the freest possible circulation occurs, hence it follows that the capacity of the pipe, as a whole, to convey water, is reduced to the full extent or proportion of the air accumulation at any one point. Thirdly, a large accumulation of sand or other settlings was found in portions of this pipe. The presence of settlings in any portion of a pipe denotes that such pipe has not sufficient current passing through or sufficient drainage or head to prevent settlings from accumulating, and this condition can be brought about in the first place by an accumulation of air, as referred to, reducing the current or flow of water through the pipe, the more open parts of which then assume the duty of settling basins in the pipe itself. It should be the duty of the engineer in charge to examine the position carefully to discover if it is not possible to not only restore the flow impeded but also to increase it in other ways. This might avoid the immediate necessity of the expensive tunnel proposed by Manserge. It is not my wish that these remarks be taken as claiming to locate by one example the source from which all the difficulties and misfortunes occur, since there are other phases to this question of doubtful reputation leaving considerable choice in the matter; but I have referred to this in illustration, as being akin to my subject, which I have also desired to make as widely interesting as possible. The above shows one instance where civil engineering is allied to mechanical, the laws controlling the flow of water through pipes being the connecting link in this case. So the civil engineer, in designing such work, must also be a mechanical engineer. You thus see that though the boiler in a system may be correctly designed and efficient under one system of radiation, it may fail to accomplish the work expected in another, and that from no fault in the boiler itself. Also, that radiators may fail to heat the space assigned to them from defects in the boiler or in some other part of the system, as for instance the size or arrangement of the connecting piping, as will be afterwards described.

Thus it is seen that in seeking to determine the efficiency of a hot water boiler or radiator, or in fact any of the units of a system, as a whole, the individual unit in question must be treated apart from other units of the system. Further, in reference to the connecting pipes between boiler and radiators, it is important that they be correctly proportioned in size or area to the various parts of the radiation they have to supply. Since the motive power of the circulation is due to the height of the driving columns, multiplied by difference in their weight, it follows that on the different floors, different proportions in the area of the connecting pipes are required so as to distribute to the radiators on the different floors their proper share of circulating power. By estimating the average height of floors, one above the other, at even distances, we are at least within the mark in stating that in a three-story house with basement, the effective proportional area of connecting pipes per square foot of radiation should run so as to give an excess of effective proportional area, etc., for the lower floor of three to one of the upper floor. This may be put in more practical shape by proposing to determine from best general practice a common unit of proportional area per square foot of radiation, which may be used when once obtained in all cases for determining, according to the nature of the work, whether or not sufficient circulating area is provided—in the boiler itself; or in the radiators themselves; or in their connecting pipes individually. This unit will be used, as follows:

Radiators having been selected and placed for the different floors, the sizes of the pipes individually required will be determined by multiplying the square feet of radiating surface in the radiators by the unit, and then by three for the radiators on the ground floor, by two for the radiators on the middle floor, and by one for the radiators in the upper story. These sizes or areas will determine, by examination of their design, if the individual radiators have sufficient water-way in themselves, and the sum total of these areas will determine if there is sufficient water-way in the boiler itself.

I will note here that since a pipe of four square inches' area will convey more than double the water of a pipe of two square inches area, this difference should be taken into account and may be found tabulated in books of reference. I will also note that it is important that the boiler is placed (on this plan), so it may give an effective height to the circulating pipes in basement equal to the average stories in the house. A boiler, where the return pipes fall completely to the floor, and begin to heat immediately on rising therefrom will thereby utilize the full height of the basement for enforcing circulation, and its water way be of more proportional value than in one less effectively placed, for which due allowance must proportionally be made. In cases where the basement lacks sufficient height, the ground floor radiators are the ones most unfavorably affected. A lack

of circulating force to a radiator can be improved by piping to the top of a radiator as in No. 1.—instead of to the bottom, as in No. 2—and may help in some instances to acquire the necessary amount. I will close this portion of my subject by a few deductions that may be arrived at from the reasoning that has preceded.

In competitive boiler tests, in which it has been attempted to make all conditions, except the boilers, the same, the most efficient boiler may show the lowest average temperature at the point where the circulation leaves—and not the highest, as has been ignorantly supposed must always be the case. Boilers that compel the water to follow a tortuous course, in order to keep the same water as long as possible in contact with the heating surfaces, destroy the efficiency of those surfaces to absorb heat, impede the circulation, and are therefore of inferior and ignorant design. Radiators that compel the water to follow a tortuous course, so it may travel all through all of the loops in order to be as fully cooled as possible, though the effect may be to show the hottest water entering the radiator and the coldest when leaving it, as compared with other radiators, are wrong and inefficient in design inasmuch as it has been shown that that system as a whole will be the most efficient where flow and return or in fact all parts of the system are nearest to the same temperature. Such a radiator was attempted to be put on the market at a recent date, but failed, I believe, in accomplishing its object. The desired efficiency of a hot water heating plant as a whole cannot be insured simply by the purchase of a boiler or radiator of good design, which may be guaranteed of high efficiency when correctly installed. The correct installing of a hot water, or in fact any heating plant, involves engineering questions that the average man, calling himself a steam fitter or pipe fitter, as a rule, knows very little of; the employment of such a man in an engineering capacity is the direct cause of so many failures in such plants to do the duty expected of them. It is foolish economy to use too small connecting pipes to save first cost of apparatus; also in using less leads than the boiler is designed to supply, and plugging or reducing the unused holes intended for circulation.

Under some exceptional conditions it may be necessary to increase the area of circulation provided for general purposes, or discard the boiler if this is not possible. It is necessary for the man who takes up this work expecting to succeed (unless by accident), to acquaint himself with such principles as in part enumerated—but which owing to the limited scope of this paper cannot be here further enlarged upon. Having shown that in criticizing the efficiency of a hot water circulating plant, as a whole, it is necessary to independently handle the different units therein; we will now proceed to the latter part of this paper, namely, how to test the efficiency of a hot water boiler apart from its radiators and connections.

Most engineers are, in a way, familiar with the testing of steam boilers, but for hot water boilers I have not yet met with any method in use that will fill the requirement which is open to ordinary mortals to follow. I say ordinary mortals, since it is a custom in the higher schools of science and art, to so burden such investigations with algebraical formulae, logarithms, calculus, etc., combining so little practical information that ordinary mortals are excluded from following, or find life too short to take up the subject in that way.

In considering the task before us, we will find we have three measurements to accurately obtain, on which to base calculations as to the amount of heat units captured by the boiler; these are:

1st. The temperature, or in other words, the proportion of heat units in the water when it enters the boiler. 2nd. The temperature, or in other words the proportion of heat units in the water, when it leaves the boiler. 3rd. The rate or quantity of the flow of the water.

It is comparatively easy to obtain the first and second values, but not the third, because of the necessity of procuring an instrument delicate enough to measure the rate of flow correctly that can be put in a pipe without obstructing it, and so impeding the circulation with injurious results. There are ways proposed for measuring, or I would rather say estimating, the amount of water passing in a pipe without obstructing it, one of which only I will refer to in order to show the difficulties to be contended with.

In Fig. 3, let A. B. be a pipe with water flowing through it. At points A. and B. we tap in small pipes C. and D., and bring their other ends together, and turned upright, as at E. The head or force of the circulation will be represented by the difference in height of the water in the two columns at E. Having ascertained the head and the size of the orifice through which the water flows, the amount passing could be accurately calculated but for one thing, the allowance necessary to be made, scientifically called the coefficient, for the friction of the piping or in other words the impediment to theoretically free circulation. To obtain this correctly requires other tests and experiments of a complicated character; also the difference in height of the columns at E. being very small would have to be taken by miscroscopic or micrometer measurements. There is another trouble; the main circulating pipes will be found in the basement, so the ends E. would have to be extended a considerable height; this would necessitate note being taken of the temperature of the water in these columns, so any variation in weight thereby could be calculated. Furthermore, as during the test, the rates of temperature and flow will be continually changing, observations would have to be continually made; this applies also to the proposition to use an ordinary water meter could one of sufficient delicacy be found. When you consider in connection with this the mass of figures necessary to be made to obtain final results correctly, you will not wonder that the ordinary mortal referred to is discouraged and dismayed. Still the problem is before us, and the question is, if we can't make a frontal attack is there any way to get around? Every man has his own way of doing things, and without wishing to show any disrespect for the methods of others, to which if presented I shall only be too pleased to listen, I beg your kind indulgence while I explain what I think is one solution of the difficulty and afterwards invite discussion or criticism of it for mutual benefit and interest.

We have already shown how the efficiency of a boiler may be influenced by defects in the system. For the purpose of testing the efficiency of the boiler itself, I disconnect it from its system of radiation and treat it separately. It has already been explained that there are three measurements to be taken, and the complica-

tions that arise where the three measurements are unknown quantities are constantly varying at all times during the test. In my practical test, I endeavor to relieve this complication by making two out of the three measurements "known quantities," and constant at all times during the test, thus leaving practically only one measurement to be dealt with during the test, and proceed to explain briefly, as follows: To the boiler, Fig. 4, is attached flow and return pipes of the full capacity provided for in the boiler, running upwards and connected to an expansion tank in the ordinary manner. In the overflow of the expansion tank at T. is placed (in preference), a recording thermometer or an ordinary thermometer, as opportunity may offer. Opening into the return pipe is a small pipe, T2, carrying a known quantity of water per minute at a known temperature. With this our testing apparatus is complete. Let me first explain how the latter parts of this apparatus can be made. Roughly, I would propose an ordinary closet tank maintaining water by tap and float at a stated level; from this tank a pipe leads to the return pipe of the boiler, the discharge of which under the head of water in the closet tank has been measured and adjusted to suit requirements; but for more close or accurate work I have devised a special water meter, driven by clock work, that will not only accurately measure an even continuous flow, but also automatically record the same. For obtaining a constant known temperature, water from a tank of melting ice should be used, or an ordinary water service which will run a stream at constant temperature may answer as well, but to be exact and sure in this measurement a thermometer should also be placed at T2, so, should there be any variation in this temperature, it can be noted and allowed for, though complicating the calculations to some extent.

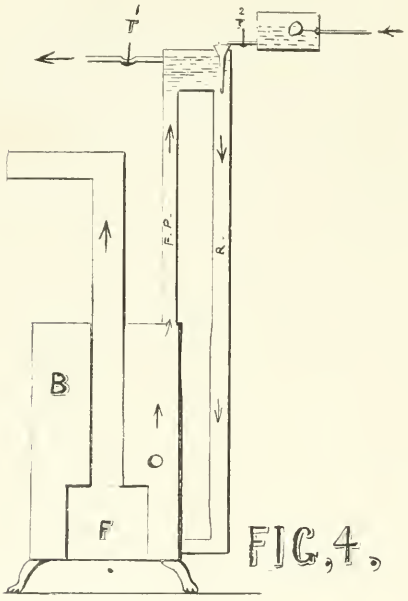


FIG. 4.

Now let me say a word on the thermometer and meter. I may be a crank on automatic machinery, possibly it is inherent laziness on my part, but instead of putting ordinary thermometers at the points indicated, and depending on taking their readings correctly (so I could swear to them), every five minutes or otherwise, during a 24-hour test, I want to put automatic recording thermometers there, of the Callendar pattern, that require no watching and will give results to a fraction of a degree and time, whose records can for evidence be photographed and reproduced in print free from the possibility of personal error. So also with the measurement of the flow, but to explain such instruments would take one or more papers, and so must be passed over for the present.

Having rigged my testing apparatus, we will proceed, as follows: The apparatus being empty of water, we will start our water meter, stopping it when the water gets to overflow, so we may know the first contents; at the finish of test the heat remaining in this water above the normal will be one of the quantities to consider and add to main results. Our apparatus and the boiler being now full, we will start the fire on a measured quantity of fuel and make a mark on the time record of the thermometer. On the water in expansion tank having acquired an ordinary working temperature, the time being automatically noted or otherwise, we start the water to circulate through the meter at a rate previously decided on as in proper proportion to the size of the apparatus, and allowing the party interested in the economy of the boiler to fire up to the best of his knowledge or ability. With automatic instruments our work is over until the completion of the test; the recording instrument being under lock and key, they cannot be tampered with. It being only necessary to insure further that the fireman is honest in regard to using no fuel but that measured out to him, so the quantity of fuel burned during the test may be determined in the usual manner.

At the close of tests we consult the records which are then the records of what has been performed. Our report, therefore, will show, backed by the records and evidence referred to, that by the consumption of a certain amount of fuel during a stated time, in a hot water circulating boiler, we have raised the temperature of a stated quantity of water a certain number of degrees, the average being determined from the temperature curves that the thermometers have recorded, thus giving simple data for obtaining both the efficiency and power of the boiler. The test would also show clearly at what part of the firing the best results were being obtained and so be a guide in this respect and in determining the best proportions for the fire surface, etc.

From the data recorded, as above, it is a comparatively simple matter to determine the number of British Thermal Units that have been abstracted from a stated quantity of fuel during a certain time for comparison with other absolute tests that may have been elsewhere made of other boilers, so giving their relative efficiency and power. Also by reducing the values to what they would be in steam evaporation from and at 212° F., the efficiency and power of a hot water boiler is made comparable with that of a steam boiler. This may seem to be getting into complicated calculations, which we desired to avoid, but that depends, like the test itself, on how you take it, whether by frontal attack or by getting round—for instance, if you ask a college professor for a rule for determining these values, especially as regards the steam comparisons, if he is

unkind at the time he may present you with something like this, which he says has been founded on experiments, and is a fairly accurate guide for a frontal attack:

$$\log. p. = A - \frac{B}{T} - \frac{C}{T^4}$$

where A = 6.1007
log. B = 3.43642
log. C = 5.59873
P. = pressure
T = temperature

But if he is kindly disposed at the time he may tell you that for his part he usually gets around it by consulting a book of tables to determine these values, where the whole thing is figured out for you in a reliable manner.

IMPORTED IMPUDENCE.

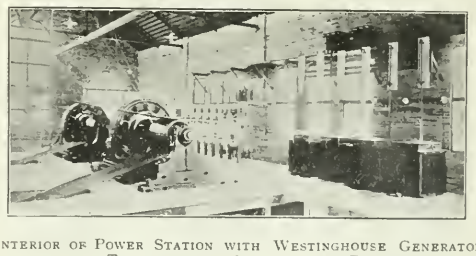
The Ontario Mining Protective Association has published a pamphlet on the Ontario Mines Act, which though written wholly in the interest of the Canadian Copper Co., has some points of interest for Canadian citizens. The front cover sets forth that "Ontario mining men protest against confiscation of vested rights without compensation; menace to the investments of capital; its effect upon the nickel and copper industries of Ontario. Mr. Clergue answered, and his ignorance of metallurgy exposed." This is very comprehensive, and one looks to derive great benefit from so intellectual and philanthropical a publication. The further facts that it is "cauld kail," from the Canadian Mining Review, and that it has been "het again," and published by the authority of the Council of the Ontario Mining Protective Association, are set forth. This last fact is of moment, because when receiving the pamphlet, we observed that it had come free through the mails, and that the wrapper bore the imprint of the Dominion House of Commons, and naturally believed the pamphlet to be a reprinted speech duly made in the House by the hon. member or members sitting for the Canadian Copper Co. It must be that a mistake was made by someone, and the O.M.P.A. printed matter has been sent out by an innocent member, instead of his own more eloquent and truthful discourse upon binder twine and ballot boxes. It seems hardly believable that a member of the Dominion House who represented anything but a corporation would have the temerity to use the franking privilege of the House to circulate a publication with the chapter "Ontario Mines Act; its unconstitutionality." Such an act is not only a fraud upon the public but it is a grave impropriety and an outrage upon the dignity of the province of Ontario. If the acts of the Ontario Government are unconstitutional, let the matter be discussed in the House, if necessary, and the Governor-General-in-Council may disallow the Act. But that the Tooley street tailors or the O.M.P.A. should pronounce privately upon the Act and employ the machinery of the Dominion Government to promulgate their findings is most grossly impertinent.

The employees of the Canada Switch and Spring Co., Montreal, held a ball, April 23rd, at Bout de l'Isle, about 250 guests being present. It was under the direction of J. Juteon, president; J. Diotte, secretary; R. Kelly and R. Cox, floor managers. The foremen of the different departments, Geo. P. Curtain, J. Hodgkiss and John Smith, were present.

METROPOLITAN RAILWAY, TORONTO.

A new power plant has been constructed by the Metropolitan Ry. Co., Toronto, and the length of its railroad has been more than doubled. The track previously extended from Yonge street, North Toronto, to Richmond Hill, a distance of 14 miles, with the power station at Deer Park. The tracks have now been extended from Richmond Hill to Newmarket, 30 miles from Toronto. The old power station has been done away with and a new one built at Bond's Lake, 18 miles from North Toronto and 12 miles from Newmarket, the present terminus of the line. There is also a sub-station, with rotary converters and transformers, at York Mills, 4½ miles from North Toronto. The railroad connects at North Toronto with all the tramway lines of the city of Toronto, and takes a northerly course in a straight line through the villages of Lansing, Glen Grove, Newton Brook, Thornhill, Richmond Hill and Elgin Mills to Newmarket. The track is laid in a very substantial manner with 70 lb. "T" rails, bonded, having the regular railway gauge of 4 feet 8½ inches, as it is intended to connect with the Canadian Pacific Railroad at North Toronto for the interchange of traffic. A Baldwin-Westinghouse electric locomotive will haul freight cars from the Canadian Pacific railroad to and from all stations on the Metropolitan Railway Company's system. At present the district through which this railway passes is served by the Grand Trunk railway only. The railroad ascends gradually from North Toronto for a distance of 22 miles to the summit of the divide or water-shed, which is between Aurora and Bond's Lake, reaching a height of 1,400 feet above the level of the lake. From this point there is a gradual descent to Newmarket. The line follows a comparatively straight course, but there are several long grades, the steepest of which is 8 per cent.

The contract for the building of the new power plant and the additions to the line was granted to the Imperial Lumber Company, Ltd., Toronto, which employed the Westinghouse Electric and Mnfg. Co. to supply the electrical plant and railway equipment. This contract comprised a new generating station and sub-station equipment, also motors for freight and passenger rolling stock and an electric locomotive.



Interior of Power Station with Westinghouse Generators and Transformers. Metropolitan Railway Company, Toronto, Canada.

The new power house is at Bond's Lake, 18 miles from North Toronto. The power house has been erected by the side of the lake, from which water for the boilers and condensers is readily obtained. The building is of brick with steel truss roof. One end of the building serves for the boiler house, the smokestack abutting upon the western wall. Adjoining the boiler house and extending 10 feet beyond it on either side, is the engine and dynamo room, containing two cross-compound condensing steam engines, belted to two 275 k.w. Westinghouse A.C., D.C. 60-cycle, three-phase generators, running at 600 r.p.m., wound for 400 volts alternating current, and for 570 volts direct current. An interior view of the power station is shown in Fig. 1. The direct current supplies the local feeders, the alternating current being carried to the transformers and transmitted to the rotary converters in the sub-station at York Mills. The generators are designed to deliver and utilize their full rated capacity at the D.C. end or at the A.C. end, or the loads to automatically divide in any proportion at either end and to generate electrical energy to their rated capacities as may be called for by the varying loads passing over the railway. Whether the demand for current be from local point near the

power house requiring ordinary direct current voltage to the trolley line, or an extra demand arises for the high voltage alternating current to the sub-station line, the generators will deliver automatically their full rated capacity in accordance with the varying demands from these two sources.

The shunt and series field coils of the generator are wound separately, having ventilating spaces between each other and the pole pieces. The generators have three bearings which are self-aligning and self-oiling. The armature cores are built up of laminated steel manufactured specially for the Westinghouse Company, with slots on the periphery arranged for the reception of coils. The closed coil winding consists of rectangular copper bars, shaped and insulated before being placed in the core. Ventilating spaces are left in the core, and at each end between the core and winding. Hard rolled copper bars insulated with mica are used for the commutator, which is mounted on the armature spider; the collector rings are connected to the same winding and placed upon the opposite end of the armature. The brush holders, both for the commutator and the A.C. collectors, are separated by lugs upon the bearings. Copper brushes are used for the collectors, and carbon in improved holders for the commutators, the latter holders are capable of being shifted by means of a wheel operating a gear in a worm. The generators are guaranteed to have an overload capacity of 15 per cent. for twenty-four hours with a rise in temperature not to exceed 50 degrees C. above the surrounding air, and to carry 40 per cent. overload for two hours, or 50 per cent. overload for one-half hour without injurious heating and sparking.

Two exciters of the standard Westinghouse type have been belted to the ends of the generator armature shafts; they are of the four pole type, compound wound, 125 volts, operating at 1,600 r.p.m., and have the same general characteristics as the generators above described, but without the A.C. collector rings. The A.C. current from the generators is carried to four 125 k.w. Westinghouse transformers of the self-cooling oil-insulated type, which are placed near the end wall of the power house. They are wound for 400 volts primary and 15,000 volts secondary, two of them being connected with each generator. The high tension current is conveyed by overhead lines to the sub-station at York Mills. The marble switchboard consists of eight panels, and occupies the end of the power house. The switchboard is arranged for the multiple arcing of the A.C. ends of

Two 200 k.w. Westinghouse Rotaries, Transformers and Switchboard at York Mills Sub-station, Metropolitan Railway Co., Toronto, Can.

the two generators, and also for the multiple arcing of the D.C. ends of the two double end generators, together with the two generators formerly used in the discarded power house of the company, which are to be rewound for present service. The two panels respectively control the A.C. ends of the two A.C.-D.C. generators. Four additional panels are provided for the D.C. end of the two A.C. D.C. generators, and for the two older generators.

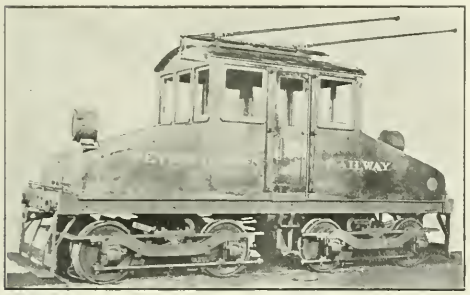
The equipment of the sub-station at York Mills consists of four 100 k.w. Westinghouse transformers, wound for 13,000 volts primary and 400 volts secondary, two for use with each rotary. The current is carried from the transformers to two 200 k.w. Westinghouse rotary converters seen in Fig. 2, which transform the 60 cycle, three-phase alternating current into a 570 volt direct current for local distribution. The rotary converters and the transformers are designed to carry an overload of 25 per cent. for twenty-four hours without a rise of more than 60 degrees C., and to carry a 50 per cent. overload for two hours, without injurious heating or sparking. The generators at the central station and the rotaries at the sub-station are constructed on similar lines, having inwardly projecting pole pieces made of soft laminated steel, so proportioned as to permit the immense variations of load without shifting the point of commutation, thus making the shifting of brushes unnecessary. The pole pieces are cast into an iron yoke divided horizontally, the lower half with two bearings cast in one piece to ensure perfect alignment.

It is projected to make further extensions to the Metropolitan Railway Company's lines, one 13 miles in length is already under construction, extending from Aurora westwards. The plans of the company anticipate a time when a large central power station will be necessary, and the present generators will then serve for rotary converters. This can be effected by removing the pulley and placing in its stead a starting motor, or bringing them up to speed by any other extraneous means, or as direct current motors. The generators are equally serviceable for the supply of energy for incandescent or arc lighting, and for power for polyphase induction or synchronous motors. The rotary converters at present are started by an induction motor, placed on the shaft of the rotary and supported on a bracket. Upon the proper speed being reached as indicated by the synchronizer on the switchboard, the rotary's switch is thrown, and it maintains its own speed, the starting motor being then out of circuit. These generators at the central station, and the rotary converters at the sub-station operate in multiple, are at both ends, and the generators are arranged to operate in multiple with the older D.C. machines previously used on the railway company's line, when the latter shall be compound wound. The transformers are constructed with the core consisting of laminated steel of the highest magnetic quality. Both primary and secondary windings are divided into several flat coils insulated separately. Loops are brought out from the low potential side so that three voltages may be secured on the D.C. end of the rotaries as desired. The terminals are placed on marble plates, the high potential at one end and the low potential at the other, the connecting wires pass through the top of the case in insulating bushings. The sub-station switchboard consists of five panels, two A.C. rotary transformer panels, two D.C. rotary transformer panels, and one double feeder panel.

Ample protection against electrical storms has been provided by equipping the station with three Wurts lighting arrester outfits for 15,000 volts for the A.C. line and a Wurts railway tank lightning arrester outfit for the D.C. side. The Westinghouse lightning arresters have a two-fold function, providing a path to the earth offering the least possible resistance to the passage of static discharges, and avoiding any interruption of service whether at the moment of those discharges, or at other times. The apparatus connected to the high potential alternating circuits is protected by a combination, consisting of a number of Wurts non-arcing metal lightning arresters in porcelain cases placed between the terminals of a bank of choke coils and the earth. Lightning or static discharges being of a highly oscillating character, the coils have a greater retarding effect, and cause the discharges to prefer the easier course to the earth through the lightning arresters. Six such choke coils interpose an effective resistance to the lightning discharges, but have no appreciable effect on the generator current. A good ground for the lightning arresters has been provided by a plate of No. 16 tinned copper, placed in a pond, which is connected by an almost straight wire with the arresters. One individual arrester has been connected with each direct current panel of the switchboard. The station apparatus is further protected by a railway tank arrester, consisting of a bank of twelve coils, leading to plates in a tank through which in time of storm a stream of water flows. The coils are connected in series with the D.C. bus bars, and are so installed that except in time of atmospheric electrical disturbances they are not connected to the bank.

The Metropolitan Railway Company has added to its rolling stock some freight cars, some of them of a heavier kind, equipped with four 38 B Westinghouse motors, also smaller ones with a double 49 Westinghouse equipment. It has also added single truck passenger cars, carrying two 38 h.p. West

inghouse equipments, and also some 45 feet double truck passenger cars with quadruple 38-B motors are designed upon similar lines only differing in capacity. In both cases the field is of four soft laminated steel pole pieces, cast into a steel yoke divided horizontally, the two halves hinged together on the side opposite the axle. The field coils, armature, commutator and brushes are completely enclosed by the two field castings, and thus absolutely protected from dampness and dust. A large opening, protected by a spring cover, is provided in the upper casting over the commutator to give ready access to that part and to the brush holders. The field coils are wound on a form and thoroughly insulated, one being placed over each pole piece, and held in place by a brass plate bolted to the yoke. The armature is of the "drum" type, of laminated soft steel with liberal air passages, the ventilated winding giving excellent



Baldwin-Westinghouse Electric Locomotive, Weighing 57,000 lbs. Metropolitan Railway Co., Toronto, Can.

ventilation. The winding is of machine wound coils insulated and slipped into slots in the core. The commutator is of hard drawn copper segments insulated with mica, and of such depth as to allow ample clearance for wear. Steel gears and pinions are used, enclosed by a tight projecting case, supported by its own bearings at one end, and the field casting at the other. The controllers are of the Westinghouse company's standard construction, of ample capacity to operate the motors at their full capacity. Resistances are made of strips of sheet iron insulated at each turn by mica and indestructible from heat. The Metropolitan Railway Company is building up a considerable freight and express business, which it intends to increase in the near future, and for this purpose has provided the electrically propelled freight cars mentioned above. These cars are engaged in carrying milk and farm produce to the city of Toronto, and general merchandise to the villages upon the road. The coal used at the central generating station has hitherto been transhipped at North Toronto into smaller cars, and hauled to the generating station by the trolley cars. The Metropolitan Railway Co. has now added to their stock a Baldwin-Westinghouse electric locomotive, which in the future will haul railway cars direct from the lines of the Canadian Pacific to all stations upon their system. By this means the cost of transhipment will be avoided, and farmers will be able to load their produce upon railway cars, and have it conveyed without transhipment to any point in the United States. The Baldwin-Westinghouse electric locomotive shown in Fig. 3 has driving wheels 33 inches in diameter, and weighs 57,000 pounds. It is equipped with four 50 h.p. Westinghouse 38-B motors, similar to those already mentioned. A complete Westinghouse air brake equipment has been provided for the locomotive, including a combined pump and motor with capacity for five cars; and in addition an efficient hand brake to all wheels. The locomotive is designed to run at a speed upon the level of 35 miles an hour, hauling cars with an aggregate weight of 60 tons.

The plants of the Welland Vale Co.'s works and the Canada Motor and Cycle Co.'s works at St. Catharines, Ont., were burned, May 16th. The fire started in the hardening department of the cycle works. This throws 500 men out of work. The Welland Vale Co.'s loss will be about $200,000, with insurance of about $85,000. The Canada Cycle and Motor Co. had an insurance of $40,000 on the machinery and $65,000 on its stock.

AN ABSOLUTE DETERMINATION OF THE THERMAL CONDUCTIVITY OF METALS.

(Continued from last issue).

THERMO-ELECTRIC EFFECTS

In the original experiments performed by Mr. King and also in the preliminaries of these experiments an ordinary brass contact key was used in the galvanometer circuit, and also mercury cups were used for terminals of the potential wires. The readings were found to be inconsistent when the current was reversed, and the cause was attributed to the different metals in the key and mercury cups, which when the temperature varied about them caused thermo-electric effects. To remedy this the mercury cups and contact key were replaced by copper binding posts and a copper key and the results then obtained were very satisfactory. The key was made of a piece of pure copper on a wooden base and connections were made to it by means of copper screws and washers.

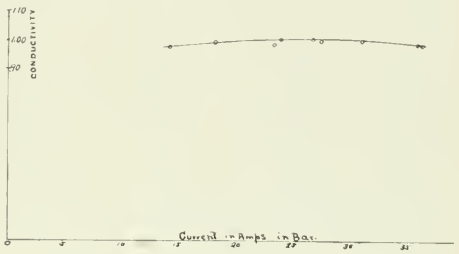


Fig. 4

METHOD OF TAKING OBSERVATIONS.

The balance points on the potentiometer with the terminal "g" of the galvanometer successively in the binding posts 1, 2, 3, 4, were obtained with the current in either direction. From these observations the resistance of the bar was obtained in terms of the .001 ohm standard. The current was measured by using a Weston milli-voltmeter to obtain the fall of potential across the terminals of the .001 standard. In this way the current could be very accurately determined, provided that the milli-voltmeter was accurately calibrated. This was done in the following manner and a curve drawn showing at a glance what should be added to or what should be subtracted from the reading of the milli-voltmeter.

CALIBRATION OF MILLI-VOLTMETER.

The milli-voltmeter did not read directly in milli-volts, five divisions on the scale corresponding to one milli-volt, hence all readings had to be divided by five after having been corrected.

The milli-voltmeter M was connected in series with standard ten *ohm* resistance R, a resistance box B, and a storage cell S. CC is a standard Clark cell of voltage = 1.4342 at 15°C. K is the contact key, G a galvanometer, P a potentiometer, and M the milli-voltmeter to be calibrated. A storage cell was connected to the terminals of the potentiometer, and a standard Clark cell was also arranged, the negative pole to the same terminal as the negative pole of the storage battery, while the positive pole passed through a contact key and galvanometer to the potentiometer movable contact. In this way the potentiometer could be standardized, the volts obtained at any time

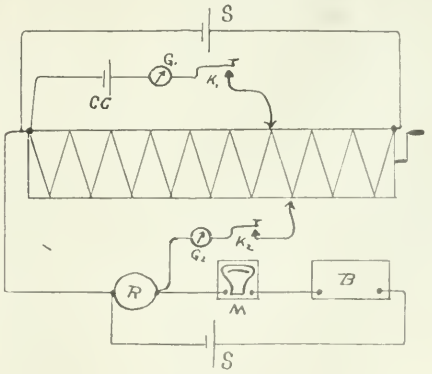


Fig. 5

[1] A paper read before the Applied Science Society of McGill University, session 1899-1900.

by adjusting the movable contact to balance the galvanometer G. From this arrangement the fall of potential across the standard ten *ohm* resistance could be found very accurately, and this would give the current flowing in the milli-voltmeter. The corresponding deflection was then observed. Readings were taken in this way for every ten divisions of the milli-voltmeter. These readings are given in columns 1 and 2 on page 14. The resistance of the milli-voltmeter was then measured and found to be .847 *ohm* at 18.°5 C. From this resistance and the several values of the current flowing the potential required to produce this current through the milli-voltmeter was calculated. The difference between this calculated potential and the potential indicated by the milli-voltmeter is given in column 4. These differences were then plotted and a curve drawn showing at a glance what was to be subtracted or added to the readings of the milli-voltmeter. A copy of this curve is given with this paper, fig. VI. Readings:

Milli-voltmeter reading.	Current flowing through M.	Calculated volts.	Differences in divisions.
10	.00117	.000995	.02 —
20	.00232	.001970	.15 —
30	.00350	.002972	.15 —
40	.00462	.003915	05 —
50	.00583	.004950	.25 —
60	.00708	.006015	.05 +
70	.00832	.007130	.65 +
80	.00948	.00804	.20 —
90	.01062	.00903	.15 +
100	.01167	.00992	.40 —
110	.01288	.01089	.55 —
120	.01390	.01080	1.00 —
130	.01511	.01284	.80 —
140	.01627	.01380	1.00 —
150	.01750	.01485	.75 —
160	.01870	.01590	.50 —
170	.01991	.01691	.45 —
180	.02100	.01790	.50 —
190	.02221	.01888	.60 —
200	.02332	.01980	1.00 —

OBSERVATIONS AND RESULTS.

Saturday, Aug. 5th, 1899.

Temperature of bath.	Current in circuit.	Direction of current.	Potentiometer Readings, No. 1.	No. 2.	No. 3.	No. 4.
18.8	2.97 amps.	—	9.484	53.841	63.042	99.162
18.8	2.97 "	×	8.457	53.828	63.015	99.158
18 8	18.25 "	—	9 385	54.345	63.449	99.164
18.85	18.25 "	×	9.397	54.339	63.434	99.165
19.0	36.18 "	—	9.090	55.778	64.564	99.194
19.0	36.18 "	×	9.098	55.772	64 566	99.195

From the above observations the following was calculated:

Resistance.	Current.	Bath Temp.	Mean Cu. Temp.	Mean Rise.	Max. Rise.
0012355	0 amps	19.° Cu	—	—	—
0012362	2.97 "	19.0 "	—	—	—
0012665	18.25 "	19 03 "	25 26	6.23	9 34
.0013571	36.18 "	19.20 "	44.02	24 82	37 23

$$Cu_a = 25.26 \therefore \frac{dCu}{dx} = 3.968$$

$$Cu_b = 44.02 \therefore " = 15\ 80$$

$$q_a = 18.25 \times .0012357 = .2058$$

$$q_b = 36.18 \times .0012364 = .8092$$

$$K_a = \frac{.2058}{3.968 \times 5205} = .996$$

$$K_b = \frac{.8092}{15.80 \times 5205} = .985$$

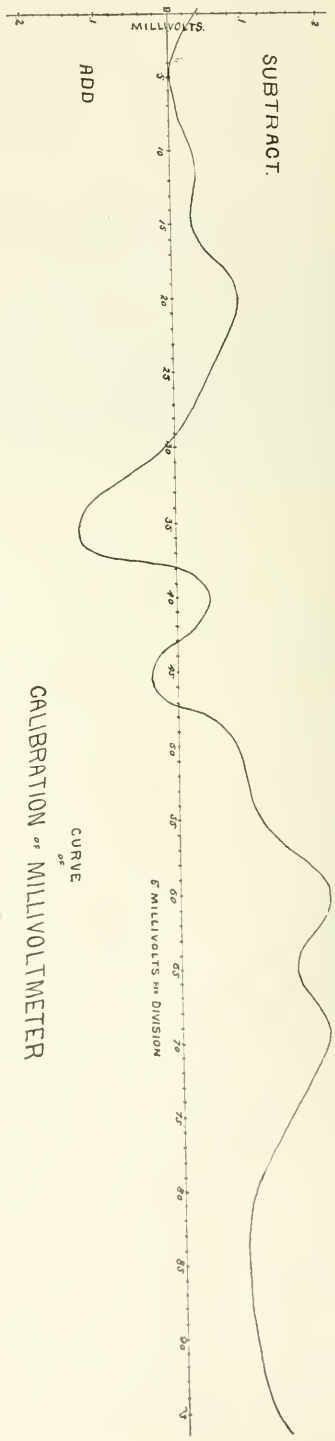
These results are very consistent, as may be seen in accompanying curve diagram of results, Fig IV

The following are the results obtained at different times during the summer, the observations being omitted for space

Date	Current.	K
Aug. 5th	18 25 amps.	996
" "	36.18 "	985
" 11th	14 59 "	1 008
" "	26 84 "	1.007
" "	36 20 "	.987
" 19th	23.5 "	970
" 21st	23 3 "	.985
Sept 9th	31 2 "	995
"	36 8 "	965

The above results have been plotted to scale on section paper and are given with this paper.

A number of other results were obtained before the apparatus was all in good working order, some of which compare favorably with those given. The experiments could not be finished during the summer on account of lack of time, and it is proposed to continue them at a later date.



On September 8th, 1899, another set of observations was taken to compare with the foregoing as a confirmatory test, with the following results:

R_0 was found to be = .0011446 at zero current, as compared with .0011445 " the mean R_0 (see page 14).

At a current of 31.2 amps. Cu. was found to be = 35.61
and Cu. max. = 27.30
also q = .600
Hence K = .997

At a current of 36.9 amps Cu. was found to be = 43.85
and Cu. max. = 39.67
also q = .837
Hence K = .960

The above results agree very well with those already given, as shown by the accompanying curve (Fig. IV.). From the foregoing data we see that the critical current is about 27 amperes, for which value of the current we find the conductivity to be 1.007. In other words, if in a cube of copper of unit dimensions (1 cm.) there exists a difference of temperature of 1° C. between two opposite faces, there will be a flow of 1.007 calories of heat from one surface to the other, in unit time, at a temperature of 33°C.

GAS ENGINE DIMENSIONS.

Prospective gas engine purchasers have always been at a serious disadvantage when deciding between different designs offered them, from the fact that manufacturers, heretofore, have not listed the size of cylinders for the different ratings of horse-power. We reproduce the dimension list of the "Model" gas and gasoline engines, built by the Goldie and McCulloch Co., Ltd., Galt, Ont., which is the first company to take this decided step, which certainly appears to be in the right direction. If it is necessary to know steam engine sizes, in order to make an intelligent choice it is evident that the same rule should apply to gas engine practice:

Actual H.P.	Speed Rev. per min.	Size of Cylinder.	Floor Space Over All	Driving Pulley	Belt
		Dia. Stroke.		Dia. Width.	
1½ to 2	250 to 350	5 in.— 6 in.	35 in. x 43 in.	10 in. x 8½ in.	4 in.
2¼ to 3	240 to 325	5½ in.— 7 in.	35½ in. x 45 in.	10 in. x 8½ in.	4 in.
3 to 4	230 to 315	6¼ in.— 8 in.	36 in. x 50 in.	12 in. x 9 in.	4½ in.
4½ to 6	225 to 300	7 in.— 9 in.	39½ in. x 54 in.	12 in. x 10 in.	5 in.
6½ to 8	215 to 265	7¾ in.—10 in.	44 in. x 66 in.	14 in. x 11 in.	5½ in.
8½ to 10	205 to 240	8¾ in.—11 in.	53 in. x 76 in.	16 in. x 12½ in.	6 in.
10½ to 12	200 to 230	9¼ in.—12 in.	53 in. x 80 in.	18 in. x 14 in.	7 in.
13 to 15	195 to 225	10 in.—13 in.	60 in. x 84 in.	20 in. x 16½ in.	8 in.
16 to 20	170 to 210	10¾ in.—15 in.	60 in. x 90 in.	26 in. x 16½ in.	8 in.

HEAVY RAILS BADLY MADE.

There was an interesting discussion at the annual convention of the American Railway Engineering and Maintenance of Way Association held in Chicago a couple of weeks ago on the rail question. It was in connection with the report of the committee on rails, and was precipitated by Mr. Peterson, chief engineer of the Canadian Pacific.

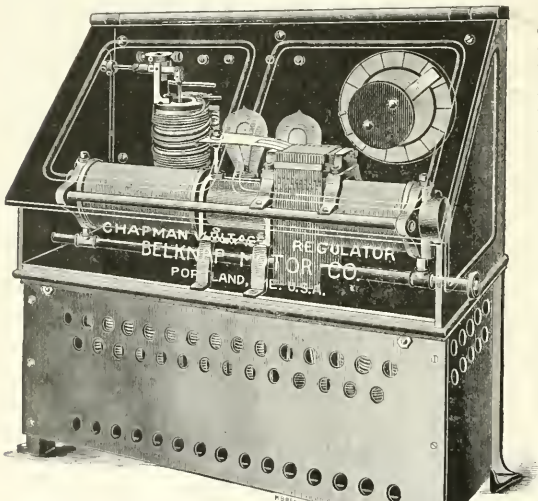
Mr. Peterson asked Captain Hunt, who is the authority on steel rails, why it was that the railways did not get as good rails as they did in the olden days. There are rails at present, 56-pound rails, in use in the Canadian Pacific laid in 1875, and which have been subjected to the heaviest use, which are better rails than the 80-pound rails the road can buy now-a-days. Captain Hunt replied that the modern rail did not give as good results as obtained from the original steel rail, or that made in the earlier days of the Bessemer manufacture, because the same care was not expended in its construction. Rail manufacturers found out that Bessemer steel could be heated to a much higher degree than was supposed. Then came competition. Railways quit ordering rails when hard times came. Good times came again with a desire to cheapen production. The result was that rails were made cheaper by making them faster and with less care. As the weight of the rail had been increased, so the effect of the heat under which the rail was worked was increased, resulting in a coarser grained steel, which cannot stand abrasion as did the old closely rolled rail. Capt. Hunt expressed the opinion that if the railways kept on increasing the size of the section they would presently have a rail head that is in character no better than the bloom from which the original rail was rolled. That is, the steel in the new heavy section rail will be no higher grade than that from which the old rail was rolled.

Discussing this feature the report of the committee stated: "It may not be out of place to call attention to the fact that many well meaning efforts at reform have been in vain, on account of the very radical position taken by some of the persons connected therewith. Therefore, if any of us incline to extreme views in such matters as high carbon or low carbon, let us find at least some common ground on which we can take a stand, and then we shall make headway, possibly slowly, but surely. If we agree on uniform sections for all our lines, we will eventually save for our companies, and possibly, in addition, increase the profits of the rail manufacturers, about which so much talk has been heard in Pittsburg recently. Let us agree on one other thing—that the mechanical treatment in rolling and the temperature at which the rail is finished is of the greatest importance—then insist on the mills making an improvement in this regard. If this association can agree on a specification for the manufacture of rail, which may not be perfect, but which will be a step in advance of what we are doing, have it approved by our companies, and accepted by the rail manufacturers, decided progress will have been accomplished.

THE CHAPMAN VOLTAGE REGULATORS AT ARMOUR CO.'S PLANT IN CHICAGO.

Each regulator consists of three essential parts, viz., a resistance to be inserted or removed from the field circuit of the generator to be regulated, a working solenoid to do the work of inserting and removing the resistance step by step from the circuit, and an auxiliary relay solenoid to determine the movement of the working solenoid. The resistance is made of German silver coils, units of the enamel resistance type or carbon. Ample carrying capacity is, it is claimed, provided so the resistance will not heat to any extent. This resistance is connected to a series of copper segments placed in a horizontal row, and having a contact slider arranged to move over their surface. This contact slider is operated by being mechanically connected to the moving core of the working solenoid. The working solenoid consists of two differentially wound coils placed on a brass tube, one at each end of the tube. The middle portion of the tube is left vacant. Inside of the tube is fitted an iron plunger, somewhat shorter than the distance through the two coils. At the centre of the plunger a rod is attached which passes out through a longitudinal slot cut in the vacant portion of the tube. The contact slider above described is attached to this rod and so moves with it and the plunger. In order to prevent too quick a movement of the plunger a simple retarding device is used. The iron plunger is hollow and the rod in its centre has a valve which can be closed and opened by turning a knob on the end to which the contact slider is fastened. The brass tube is closed at its end and completely filled with oil. The movements of the plunger towards either end can take place only as it displaces the oil and causes it to move through the hollow plunger. The rapidity of the movement can be very

finely adjusted by means of the valve above described. The force tending to move the iron plunger depends on the balancing of oppositely wound coils against each other and this balancing is determined by the action of the small auxiliary solenoid, whose only work is to cause one or another of two platinum pointed screws to make contact with the brass lever supporting its core. Contact with one screw causes perfect neutralization of the differential coil at one end of the working solenoid, and so disturbs the balance and causes the plunger to move toward the other coil. And contact with the other screw causes neutralization of the coil at the other and a movement in the opposite direction. The small solenoid may be wound to suit a variety of purposes, any one of which may be required in fulfilling the demands of station regulation. It may be wound with a simply fine winding to be connected as a shunt across the lines to be regulated, and in this case it will secure constant potential regulation at the point of attachment to the line. Or secondly, it may be wound with a fine wire as before, and also with a coarse winding. The fine winding connected as a shunt to the line,



Balknap Automatic Voltage Regulator.

and the coarse winding in series with the line. In this case it will regulate for constant potential at some distant point on the line which may be pre-determined by the setting of an adjustable compounding switch provided as a part of the regulator. Or, thirdly, the small solenoid may be wound with a single coarse wire placed in series with the line, in this latter case it will secure regulation for constant current in the lines. But whatever be the nature of the regulation the small solenoid will perform its duties with an accuracy as close as 1 per cent. above or below the normal, and is adapted to either direct or alternating currents. Alternating currents are claimed to be especially capable of close regulation by this instrument as the slight jar incident to its flow through the small solenoid almost entirely eliminate the element of friction at the pivots of the lever supporting the core, and it will easily recognize a change of half of a volt on a 110 volt circuit.

The Armour Co.'s plant at Chicago, which has just been started, is considered one of the largest in the world. It has a most expensive switchboard, and three No. 1 Belknap automatic voltage regulators on the front.

C. H. Wellman, of the Wellman Seaver Engineering Co., Cleveland, U.S., with Mrs. Wellman has gone to Europe. Mr. Wellman is chief engineer of the company; and the occasion of his departure was made the occasion of a most friendly demonstration on the part of the company's employees towards its chief engineer.

FIRES OF THE MONTH.

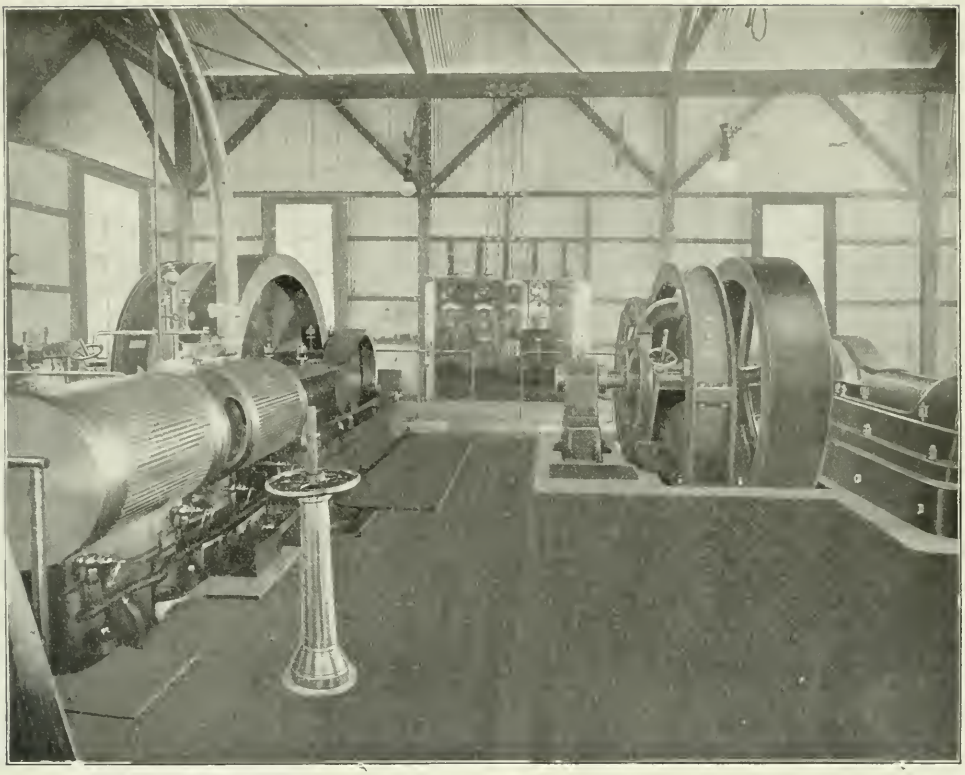
May 11th. Steamer "Marie-Louise," owned by J. Parkin, Lindsay, Ont.; damages, $3,500; insurance, $1,000.——May 16th. The Welland-Vale Mnfg. Co.'s works, St. Catharines, Ont.; damages, $200,000; insurance, $85,000; the Canada Cycle and Motor Co.'s plant, St. Catharines; damages about $50,000; fully insured.——May 16th. The pumping plant of the Charlottetown, P.E.I., waterworks.——May 16th. Steamer "Paul Smith," owned by R. Bickerdike, burned in the locks at Lachine, Que.——May 19th. Northern Elevator Co.'s elevator at Oakville, Man.——May 24th. Angus Plewes' flour mill at Markdale, Ont.; loss about $10,000.—— May 27th. Tellier, Rothwell & Co., chemical manufacturers, St. Dezier street, Montreal; damages, $30,000; fully insured.——May 30th J. C. Wilson & Co.'s paper mill, St. Jerome, Que.; damages, $10,000; fully insured; a new mill to cost $100,000 will be at once built.

EXPLORING NEW ONTARIO.

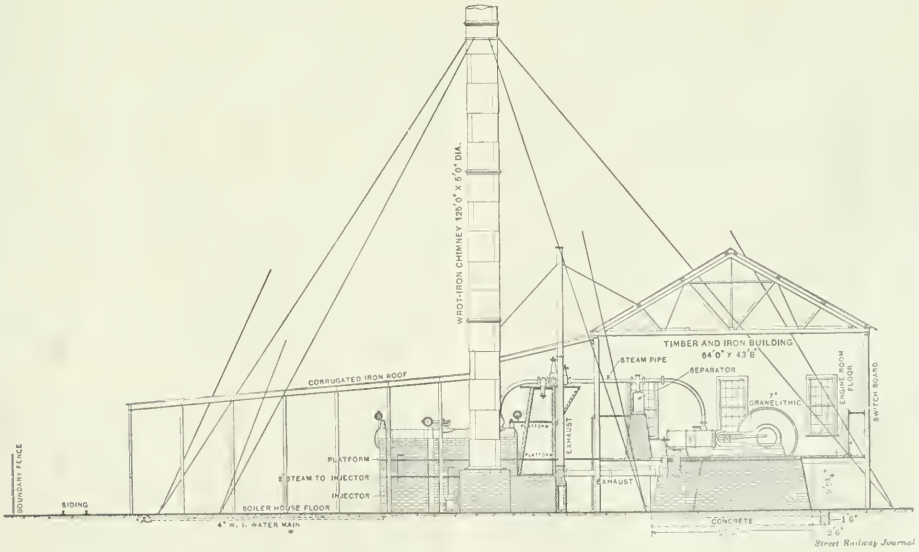
The Ontario Government is sending out ten parties to explore the northern and western portion of Ontario, the first party is under T. B. Speight, Toronto, and the Abitibi river and lake will be the district in which they will work to survey an astronomical line. A. Niven, of Haliburton, will have a party to continue the line of Mr. Speight to Missanabie river. Under the direction of H. S. Davidson, Sarnia, a party will explore the Kabinakagami river down to Moose river and then the Moose river. The party with Wm. Galbraith, Bracebridge, are to start from Jack Fish Bay, go to Long lake, down the Kenogami to Albany river, thence to James Bay. J. M. Tiernan, Tilbury, leads a party from Lake Nepigon up the Ombahika river and down the Albany. The party with James Robertson, Glencoe, will start from Lake Nepigon at Wabinosh bay, through the chain of lakes, across the height of land, down the Albany river and up again to Lake St. Joseph and Savant river and lake. H. B. Proudfoot, of Fort William, is in command of a party to go from Dinorwic on the C.P.R. in the Rainy River district up to Lake Minnietakie and along the Root river taking in all the country. A micrometer and track survey of Sturgeon lake is to be made. David Beatty, Parry Sound, and his assistants explore southwest of Lake Nepigon to Dog lake, and up the Gull river. The country and lakes between Wabigoon and Rat Portage, north of the C.P.R., will be surveyed by the party of T. R. Deacon, of Rat Portage. Demorest and Sylvester, of Sudbury, will explore between Lake Temagami and Montreal river. All of the parties are to explore the different sides of the lakes and rivers and gather information as to general character of the country, timber, minerals, soil, etc.

CANADIAN ENGINES IN WESTERN AUSTRALIA.

Perth is the capital and largest city of Western Australia, with a population of about 36,000. In spite of the size and general prosperity of the city, no tramways of any description had been built previous to the system recently completed. In April 1897, a concession for thirty-five years was granted by the Government to the Perth Electric Tramways, Ltd. No progress was made until September, 1898, when J. G. White & Co., New York, were retained as engineers. They submitted plans for the construction of a line of the most substantial character, which were approved by October 1st, and authority given the engineers to purchase the necessary materials and apparatus, all of which, except crossties, wood poles and cross arms, were shipped from the United States and Canada. Work on the permanent way of the first section, consisting of about five miles of track, was commenced, March 10, 1899, and finished June 15. The concession stipulated that the tramway company was to pave the roadway in the centre of the city for a width of 16 feet with wood block paving. The blocks were of Western Australia jarrah wood, sawn 3-in. x 9-in. x 6-in., and laid on a foundation of concrete 6 inches thick. Owing to the excessive expansion of the blocks during the rainy season, it was necessary to insert "Mastic" joints between them at fixed points. The joints consisted of ribbons or sheets of asphalt and tar to take care of the expansion and prevent buckling. The surface of the roadway on either side of the 16 foot strip was paved in a similar manner by the city authorities. The rails used



Canadian Engines in Western Australia.



Canadian Engines in Western Australia.

through the wood paved sections are 9-in. 84 lb. grooved girder rails, with 36-in. joint plates fastened with twelve 1-in. bolts, and were furnished by the Pennsylvania Steel Co. These rails are spiked to a 3-ft. 6-in. gauge, which is the standard of the Western Australian Government railways, and was specified in the concession. The overhead line work is of wrought iron tubular poles of 4 in., 5 in. and 6 in. sections, furnished by R. B. Corey, of New York. These poles were set in the ground to a depth of 6 feet, and imbedded in concrete. The car house is of brick 204 feet long, 69 feet wide and 18 feet high on the inside between the tops of the rails and bottom cords of the trusses. This building has the first and only roof in Western Australia built of structural steel. The structural work was executed in the shops of the Keystone Structural Company at Roger's Ford, Pennsylvania. Owing to the high freight rates, the trusses could not be shipped in sections as is usually done. They were assembled at the works, all holes reamed in place, the pieces marked with steel stamps, and shipment made in bundles with no two pieces riveted together. As it is possible the company may enter the lighting and power field, it was decided not to erect a permanent building for the power station. The machinery was placed on permanent foundations and a temporary station erected so as not to interfere with the permanent building when it is decided to proceed with it.

The engines are tandem compound, side crank type, and were built by the Robb Engineering Co., Amherst, Nova Scotia. They are 300-h.p. each, and are direct connected to General Electric m.p. 550-volt railway generators, running 150 revolutions per minute. The rolling stock consists of ten 18 foot closed cars of the cross-seat, centre aisle pattern, with a seating capacity of twenty-eight persons, and ten standard closed cars with longitudinal seats. The cross seat cars were built by the J. G. Brill Company, while the others were supplied by the Jackson & Sharp Company. The handling of construction material along the line was exceedingly difficult on account of the poor condition of the roads, which in many places consisted only of loose sand. A great many difficulties were also encountered during the construction of the overhead work, owing principally to the fact that the telephone, telegraph and electric light wires had been put up several years before without any regard to the possibility of a trolley road being built. Nearly all these wires had to be raised the full length of the line, necessitating the setting of longer poles and the transfer of the wires. The head of the tramways company is A. H. P. Stoneham, London, Eng. E. E. Rogers is managing director at Perth, and H. J. Somerset, formerly superintendent of the Winnipeg street railway system, is superintendent.

Industrial Notes.

Maria street bridge, Ottawa, has been pronounced unsafe.

A $15,000 Y.M.C.A. building will be built in Owen Sound, Ontario.

Geo. and Wm. Clark will manufacture woodenware at Sutton, Que.

The Berlin, Ont., Furniture Co.'s new factory will be four stories high

Long and Thompson, Orillia, Ont., are building a large brick foundry.

Sherbrooke, Que., is discussing building a new city hall and public library building.

The Percival Plough and Stove Company, Merrickville Ont., is enlarging its premises.

The Georgian Bay Portland Cement Co., Ltd., has increased its capital from $95,000 to $250,000.

Port Dalhousie, Ont., voted a bonus of $6,500 to the Toronto Rubber Shoe Co., May 21st.

The capital of the Sun Oil Co., Ltd., Hamilton, Ont., has been increased from $15,000 to $50,000.

Jos. Brown, Acton, Ont., will build a planing mill and sash and door factory in connection with his sawmill

Price, Marshall & Co., Ltd, Norton, N.B., will build a confectionery factory, 40 x 90 feet, three stories, at once

Brandon, Man., will probably bonus the Hamburg Mnfg. Co., which proposes to add a sash and door factory to its sawmill.

It is said that Wood, Vallance & Co., Hamilton, Ont., will go into the manufacture of bent wood in Belleville, Ont., on a large scale.

A board fence eight feet high and four miles long is building around the premises of the Dominion Iron and Steel Co., Sydney, C.B.

Brantford, Ont., is discussing the buying of the Gas. Co.'s plant. The probable cost is $100,000. The present earnings of the plant are $19,000.

Watford, Ont., has installed a small Model gas engine, built by Goldie McCulloch Co., Ltd., Galt, Ont., to pump water for street watering purposes.

Goldie, McCulloch Co., Ltd., Galt, Ont., reports quite a satisfactory demand for the Model gasoline engines, and in one week recently shipped eleven of these engines.

Wm. Davis & Son, Cardinal, Ont., will, it is said, require two years to complete their contract for the masonry work of the Quebec bridge.

W. Bremner, C. H. Crowe, F. Crowe, D. A. Gordon, Rachael Badder, Wallaceburg, Ont., have been incorporated as the Riverside Canning Co., Ltd., Wallaceburg, Ont.; capital, $50,000.

Gardner Bros, handle manufacturers, who lost their mill in Leamington by fire some time ago, are moving to Walkerville, Ont, where they will occupy the building formerly used as a basket factory.

Exeter, Ont., has bought a 6-h.p. Model gasoline engine and a 4 x 6 triple power pump from the Goldie, McCulloch Co., Ltd., Galt, Ont., to be used to fill the fire tanks and supply the water necessary for street watering.

The machinists employed by the Fensom Elevator Works, Toronto, received an advance of 12½ per cent. last month. The advance had not been asked for by the men, and is an evidence of the prosperity of this well-known firm.

A. C. Petersen, W. H. Sumbling, C. E. Jarmain, Toronto; J. Smale, North Toronto; H. E. Bydwell, Montreal, have been incorporated as the York Laundry Machinery and Supply Co.; head office, Toronto; capital, $40,000.

E. W. B. Snider, W. W. Snider, St. Jacobs, Ont.; H. W. Anthes, L. L. Anthes, Toronto, and C. W. Snider, Waterloo, Ont., have been incorporated as the Toronto Foundry Co., Ltd.; head office, Toronto; share capital, $50,000.

Ten years ago the Nova Scotia Steel Co., Ltd., reduced wages ten per cent.; last year the old rate was restored, and in October an advance of five per cent. was granted, and a month ago a further rise of nine per cent. took place.

J. Curry, T. McLaughlin, A. Bates, W. Maguire, E. H. Hilborn and W. C. Price, Toronto, and T. H. Goodison, Streetsville, Ont., have been incorporated as the Canadian Steam Carriage Co., Ltd.; head office, Toronto; share capital, $250,000.

The bylaw to guarantee the debentures of the G. McLagan Furniture Co., of Stratford, Ont., to the extent of $30,000, has been passed. The factory will be 250 feet by 40 feet, of brick, four stories high, to cost $40,000, and will employ on an average 150 men the year round.

C. D. Cramp, W. M. Cramp, Philadelphia, Pa.; A. H. O'Brien, H. M. E. Evans, Ottawa; A. McLean Macdonell, F. A. Anglin, J. A. Currie and Neil McLean, Toronto, have been incorporated as the Cramp Ontario Steel Co., Ltd.; head office, Collingwood, Ont.; share capital, $5,000,000.

Firstbrook Bros., manufacturers of packing boxes, etc. Toronto, have bought the factory and premises of the Midland Box, Shook and Planing Co., at Dollartown, near Midland, Ont. Extensive alterations and additions are to be made to the plant, which is to be run in connection with that in Toronto

The combination of the leading stovemakers of Canada is said to now be practically complete. All the large manufacturers except the Gurney Co., Ltd., of Toronto, have, it is said entered the trust. The damage to local interests in many places will be very great, but compensating advantages in the way of cheapened production may be obtained

A building to contain the science classes in connection with the Truro, N. S., Normal School, is to be built.

The Canada Mining and Metallurgical Co., Ltd., is applying for the enlargement of its capital stock to $10,000,000.

Port Hope, Ont., has carried a bylaw to raise $20,000 for extension and improvement of the waterworks system.

It is proposed to buy the Athletic Club building and grounds on College street, Toronto, for the Technical School.

J. H. Hall, who recently resigned his position as superintendent of the Wortman & Ward foundry, London, Ont., has removed to Brantford.

It is proposed to locate at Sandwich, Ont., a number of the large Michigan sawmills that are being driven out of that country through lack of material.

J. W. Munro, T. Mackie, W. Russel, jr., C.E.; J. R. Lockhart and J. G. Forgie, Pembroke, Ont., are being incorporated as the Alumette Oil Co., Ltd., to develop the oil finds reported from the Pembroke district some time ago.

The city engineer of Halifax, N.S., recommends the adoption of water metres to prevent waste, as the present water supply is found insufficient, and an increased supply could only be had at an enormous expense.

It is understood that the contract for the erection of the new Canadian Pacific Ry. station at Ottawa, has been given to T. Thompkins, Brockville, who built most of the Canadian Pacific Ry. stations in the Northwest and British Columbia, as well as the Hotel Vancouver, belonging to the same company.

Prescott, Ont., has given the Imperial Starch Co., Ltd., a site, valued at $8,000, and tax exemption for twenty years. The town also agrees to furnish the company electric energy for one hundred lights and supply them with one hundred thousand gallons of water daily free of charge, for the period of twenty years. In return for this the company will grind 1,000 bushels of corn daily.

The Edmund Hall Co., Alpena, Mich., U.S., has bought the property on the bay shore at Sarnia, Ont., from Nelson north to Exmouth street, about 800 feet frontage, and extending from the Grand Trunk track westward across the bay and across Sand Point to deep water in the River St. Clair. Here extensive saw mills, to employ a couple of hundred men, will be built. This is one of many such transfers of industry from Michigan to Ontario, the result of the present timber policy of the Ontario Government.

James Cowan, ex-Dominion Arbitrator, died at his residence, Craigie Lea, Galt, Ont., May 22, in the 98th year of his age. Deceased was born near the Vale of Yarrow in 1803, and has been a resident of Galt and vicinity since 1834. The late Thomas Cowan, postmaster at Galt, was a son of deceased. The surviving members of the family are J. Lang Cowan, residing at Clochmor, the farm homestead near Galt; William Cowan and A. B. Cowan, of the firm of Cowan & Co., Galt, and Miss Cowan at Craigie Lea.

The Municipal Technical School, Manchester, Eng., has ordered from the Robb Engineering Co., Amherst, N.S., a 150 h.p. tandem compound engine, to be directly coupled to dynamo, from Dick, Kerr & Co., London, Eng., for electric lighting. The order was given on the recommendation of Dr. J. T. Nicolson, professor of engineering, who was formerly at McGill University, and the purchasers state that this engine is to be placed with other engines of the leading British makers as an example of the best English and foreign practice in engineering, which is certainly a very great compliment to our enterprising friend the Robb Engineering Co.

In gathering information for the Historical Mining Series to commence in The Herald, says The Marmora Herald, May 10th, we have unearthed a few yards from our door, where the old furnace stood, a fire-brick and piece of partly smelted iron. They are now placed in our office window. The bricks were imported from England and cost laid down here 20 cents per pound. They are stamped "Farnley Iron Works, Wortley, Leeds." Each brick is numbered and they are of different shapes and sizes to fit in the proper places in the furnace. Considering that they were imported in 1820, they are of considerable interest.

A school building to cost $30,000, will be built at Sydney, C.B. C. B. Chappell, Charlottetown, P.E.I., is architect.

The building of a $50,000 hotel is now going on at Springbank, a suburb of London, Ont.

Sussex, N.B., is sinking a trial artesian well. If a satisfactory flow is secured, wells sufficient for the water supply of the town will be sunk and a waterworks system installed.

Moore & Henry, architects, London, Ont., have taken out a permit for the new Masonic Temple to replace that burned some time ago.

A creamery with a daily output of 12,000 pounds of butter is shortly to be established in Ottawa, Ont., it is reported. The capital of the company that has been organized is $25,000.

Smith's Falls, Ont., will lay granolithic sidewalks this season. Willis Chipman, C.E., will act as consulting engineer to the town in the improvements now going on.

The Maritime Anchor Wire Fence Co., Truro, N.S., has a contract to supply the I.C.R. with 50 miles of fencing to be used in Nova Scotia.

Cornwall has just paid $110,000 for the waterworks taken over from the company which put them in. The matter has been in litigation for three years, and the costs have been $22,000.

The Montreal Harbor Commissioners have accepted the proposal of the Connors' syndicate to build a one million instead of a three million bushel elevator. The remaining storage capacity is to be supplied by warehouses.

The Woods Motor Vehicle Co., of Buffalo, N.Y., was incorporated in the State of New York, May 29th. Its capital stock is $300,000. The directorate, besides being composed of Buffalo and New York capitalists, includes the names of D. Rankine, Niagara Falls, and Fred. Nicholls, Toronto, Ont.

The Schofield Woolen Co., which recently lost a large portion of its premises in Oshawa, Ont., by fire, is said to be open to offers to locate in some other town if sufficient inducements are secured. St. Thomas, Ont., is making an effort to secure the industry.

The Britannia Company of Colchester, Eng., makers of nearly 300 varieties of engineers' tools, etc., announce that they are open to appoint a sole agent in Canada; and they are also prepared to act as English agents for a first-class Canadian firm in engineers' specialties.

A fire bylaw affecting the entire city of Hull, Quebec, has been adopted by the Hull city council. By its regulations all dwellings, stores, and factories erected in the city in the future must be fireproof. All sheds, stables, outbuildings, if built within 60 feet of a street, must also be made proof against fire.

Hon. R. R. Dobell has notified the Mayor of Levis, Que., that the projected works at that place will be commenced without delay. They will cost at least $300,000 and include the construction of a new station, the conversion of the old one into post and customs offices, and the building of wharves to permit the largest steamers to discharge and take cargo at Levis.

B. Shepherd, J. E. Aldred, H. Semple, L. B. Copeland, R. W. Douglas, Montreal, have been incorporated as the St. Maurice Water Supply Co., Ltd.; capital stock, $25,000; headquarters at Shawinegan Falls, Que.; to furnish water, not including water power, to the people of Shawinegan Falls, and adjoining municipalities.

H. McC. Hart, R. E. Harris, Halifax, N.S.; E. Dickie, Upper Stewiacke, N.S.; E. P. Allison, Halifax; N. H. Stevens, H. J. Stevens, Ada J. Stevens, J. A. Walker, Chatham, Ont.; Jas. Rutherford, Blenheim, Ont., are being incorporated as the Canada Flour Mills Co., Ltd.; capital stock to be $650,000; chief place of business, Halifax, N.S.

An important industry is promised from the incorporation of the Grey & Bruce Portland Cement Co., of Shallow Lake, Ont., with a capital of $190,000, head office, Owen Sound, with the following provisional directors: J. McLauchlan, J. George, J. H. Spence, J. Young and J. E. Campbell. The objects of the company are to quarry, manufacture and sell Portland cement, putty, tiles, bricks and such material.

The bicycle manufacturing carried on by the Canada Cycle & Motor Company at the Welland-Vale Works, St. Catharines, Ont., will be continued in Brantford. The St. Catharines works, which were burned last month, will not be rebuilt.

The Canadian Steel Co., Welland, Ont., held its first meeting in Toronto, May 15th, when E. A. C. Pew was elected president, and L. E. Hinckley, New York, vice-president of the company. Mr. Hardebeck was appointed secretary pro tem. The selection of directors was not completed. E. M. Butz & Co., Pittsburg, Pa., engineers and architects, will have charge of the construction of the plant.

The Bethlehem Steel Co., Bethlehem, Pa., recently invited the superintendents of the leading United States machine tool makers to witness a test of the new steel which it is using for lathe tools. If the facts shown by the test can be brought into use on a commercial scale it will revolutionize the machine shop practice of the world. It was shown on steel cylinder cutting off work the lathe could be speeded up to three times the speed of the best present machine practice. We shall watch the future development of this new steel.

The Newfoundland Railway, which crosses the island colony and has a mileage of some 600 miles, and which is owned and controlled by R. G. Reid, Montreal, may soon pass into the hands of a company, together with the fleet of coastal steamers and telegraph services. He also owns the electric street railway in St. John's, and has a monopoly of the greater part of the minerals of the colony, together with extensive pulp areas and timber limits. Mr. Reid is now endeavoring to float a company with a capital of $27.000,000 to take over all his belongings, rights and franchises, and conduct and operate the same. It is understood that the greater part of the capital can be obtained in England, but before the scheme can be accomplished it is necessary for Mr. Reid to have the sanction of the Newfoundland Government. Mr. Reid will leave for St. John's in a few days.

Electric Flashes.

Robert Bell, electrician for the Welland, Ont., Electric Light Co., has resigned.

The Guelph, Ont., street railway will shortly be connected with the C.P.R. there.

Strathcona, N.W.T., will vote on a bylaw to spend $2,000 on a municipal lighting plant on the 12th inst.

The municipality of Winnipeg has offered $100,000 for the commercial lighting plant, which it is anxious to municipalize, the experiment of street lighting having turned out so well.

D. S. Perrin & Co., biscuit makers, London, Ont., have ordered a 50-k.w. generator from the Electrical Construction Co., London, Ont.

Brockville is taking steps to buy out the electric lighting and gas plants with a view to civic control. Willis Chipman, C.E., is making a report on the value of the plants for the town.

W. E. H. Massey has installed a plant sufficient to light all the buildings on his farm at East Toronto, Ont., and supply necessary power, and also to light the village; the municipality proposes to buy current from him and install its own lamps.

The Electrical Construction Co., Ltd., London, has recently received orders for nine motors of various sizes from its agent in Montreal, and five from its Winnipeg agent, and four from Toronto.

W. H. Meldrum, J. H. Fisher, J. Walker, J. McL. Hall, J. R. Inksater, P. H. Cox, R. L. Murray, T. Shawcross and G. B. S. Jones, Paris, have been incorporated as the Paris Electric Light Co., Ltd.; capital stock, $20,000; chief place of business, Paris, Ont.

J. A. F. McCabe, J. A. Begin, E. A. McCone, L. Duchesneau, M. Bourassa, Windsor Mills, Que., and H. A. Meagher, M.D., Montreal, have been incorporated as the Windsor Electric Co., Ltd.; capital stock, $24,000; to supply heat, light and power in Windsor Mills, Que.

St. Louis, a suburb of Montreal, is preparing a by-law to annul the franchise in that municipality of the Montreal Park and Island Ry. Co., as a result of a Superior Court judgment.

The Hamilton city council has granted permission to the Cataract Power Co. to run freight cars, coming in from Dundas, at certain hours through its streets. Express cars containing perishable goods may be run at any hour.

The Greenwood & Phoenix Tramway Co. has been organized for the purpose of building a tramway line from Greenwood to Phoenix with branches into Deadwood, Wellington and Summit camps, B. C. The line will connect with the Great Northern Railway.

Jas. Milne has reported on the proposed Cannington, Ont., Fenelon Falls, Ont., power plant, as costing at least $18,500, and he states that he is unable to find evidence of there being sufficient water for the proposed development.

The Cataract Power Co. is extending its power line from the Victoria avenue transforming station, Hamilton, to the village of Burlington. It is the intention of the company to furnish electric light for the new Hotel Brant, and it may undertake a contract to light the entire beach.

The Voltage Storage Battery Co.'s new factory in Lottridge street, Hamilton, will be occupied this month. This company is now shipping to Canton, Pa., a storage battery of a capacity of 1,000 ampere hours, and another large battery is being made for export to Peterboro, New Hampshire.

The widow of Geo. Peace is suing Montreal for $10,000 damages for herself and minor children, consequent upon the death of her husband, who was killed by an electric shock at the incinerator, on November 10th last, while moving garbage with an iron bar which came in contact with the wire of an electric light. Negligence on the part of the city is alleged.

The Canadian Electrical Association will not hold its annual convention in Ottawa in June, as intended, owing to the destruction of so many of the electric plants in the recent fire. The executive committee will appoint a time, and also a place if later on Ottawa is found to be still unable to afford sufficient points of interest for the convention, which will probably be held in September.

The Cataract Power Co., of Hamilton, is now installing two new dynamos at their power station, DeCew's Falls. The new machines will have a capacity of 2,000-k.w. each with an overload capacity of 3,000-k.w. These will be ready in August, and will increase the capacity of the plant from 3,000 h.p., which was all that Hamilton was expected to require for some time to come—to 10,000 h.p. The company's business, therefore, has already gone beyond the anticipations of its promoters.

Some Chicago men, D. S. Wegg, J. P. Wiborg, G. K. Clutton, W. H. Dayton and G. H. Pope, have been incorporated as the Anglo-American Power Company, Ltd., with a share capital of $5,000,000, to acquire the Jenison water powers franchise on the Kaministiquia river, near Port Arthur, Ont. The company is empowered to sell and distribute power, compressed air, electricity, or power in any form developed from these properties. It is this enterprise to which Port Arthur looks to make it a great manufacturing centre.

The Electrical Construction Co., Ltd., London, Ont., reports the following sales recently made: George May & Sons, Ottawa, Ont., one 5-h.p. motor; C. D. Burdick & Co., London, Ont., one 10-h.p. motor; the London, Ont., Pant and Overall Co., one 6-h.p. motor; E. Parnell, London, Ont., one 8-h.p. motor; J. P. Archibald, Ingersoll, Ont., one 15-h.p. motor; Timbell & Co., London, Ont., one 3 h.p. motor; C. Kennedy, London, Ont., one 3-h.p. motor; H. W. Petrie, Toronto, Ont., one 12-h.p. motor; F. Raney, Kingston, Ont., one 8 h.p. motor; W. Carson, Kingston, Ont., one 3 h.p. motor; N. H. Good, Berlin, Ont., one 3 h.p. motor.

The Chambly Water & Power Co. is about to add very largely to the present plant at Chambly, Que., and before long there will be developed some 30,000 h.p. The present plant is now furnishing 7,500 h.p. The development of an additional power at St. Therese Rapids, some three miles up the river from the present plant, will be undertaken. Peter Lyall has the contract for additional masonry, and when this is completed and the electrical plant installed the works will be capable of developing 20,000 h.p. The new works, which it is proposed to erect at the St. Therese Rapids, will when fully developed give an additional 10,000 h.p.

Marine News.

The Hamilton Steamboat Company's steamer "Mazeppa" has been sold to John McLachlan, Owen Sound, Ont.

Knapp's roller boat is still navigating its inventor's brain, if no other element, and he is reported to be about to build a new boat for Montreal capitalists, who are interested.

A new cargo steamer of 7,000 tons capacity has passed into the hands of the Allan Line. It is to be named the "Ontarian," and will be employed in the service between Liverpool and Montreal.

The Dominion Line has ordered some larger steamers. The latest addition to the fleet was the New England, of 11,406 tons, but there are now on the stocks to its order two sister vessels (one to be called the "Commonwealth"), which will each have a tonnage of 13,000. The vessels are for the Boston route.

Dredge No. 4, built by Carriere, Laine & Co., Point Levis, for the Montreal Harbor Commissioners, is successfully at work. The new dredge has a steel hull and boom, and in general appearances looks the same as the other dredges, but is much more powerful.

The New York State Legislature has passed an Act to remove the limit of $50,000, above which no company might capitalize which did business on the Erie Canal. This will increase the capacity of the canal considerably by introducing more improved methods of transport, handling, etc.

A. W. Hepburn, of Picton, has sold the "Argyle" to a new navigation company formed to do the north shore trade of the towns on Lake Ontario from Toronto east to the Thousand Islands, to be known as the Toronto, Oshawa and Thousand Islands Navigation Co.. The capital is $100,000. The development of a summer resort at Whitby is a subsidiary enterprise.

The Committee on Foreign Affairs of the U. S. Congress has acted favorably on the joint resolution authorizing the President to invite Great Britain to join in the formation of an international commission, four from each Government, to consider the diversion of waters along the boundary of the United States and Canada. The enquiry is designed principally to ascertain the effect of the level of the Great Lakes caused by improvements at the Welland canal, Sault Ste. Marie canal, and the Chicago drainage canal. The enquiry covers the entire lake region, including all the waters of the lakes and rivers whose waters flow by the River St. Lawrence to the Atlantic ocean. The joint resolution has passed the Senate.

The steamer "Ottawa," built by the Bertram Engine Works Co., to the order of J. R. Booth, of Ottawa, for the Canada Atlantic Transit Company, is to run between Parry Sound and upper lake ports. The steamer is 257 feet long over all, 43 feet beam, 25 feet 6 inches deep, and will carry over 70,000 bushels of wheat on the canal draught of 14 feet. On the Upper Lakes draught she will carry over 105,000 bushels of wheat. She is constructed with cargo ports, six in number, and a complete package freight steel deck, with hoisting arrangements suitable for handling package freight in the most modern and approved manner. The machinery consists of a triple expansion engine 17 inches, 28 inches, and 46 inches diameter of cylinders, and 32-inch stroke, intended to develop about 700 indicated h.p. The boiler is 13 feet 6 inches in diameter and 12 feet long, and is provided with the Howden hot draught arrangement. The steam pressure carried is 170 pounds. There is also a donkey boiler 7 feet 6 inches in diameter, provided for running the electric lights, etc., when in port. This is said to be the largest steamer ever built on Lake Ontario. E. J. Chamberlin, general manager of the Canada Atlantic Railway Company, and also of the Canada Atlantic Transit Company attended the launching.

—The T. Eaton Co., Toronto, is making extensive changes in its electric plant, and has ordered two 350 h.p. tandem compound engines for direct connection to dynamos from the Robb Engineering Co. The two dynamos will be 225-k.w. machines from the Canadian Electric Co. In the extensions to the Eaton Company's premises there will be five new Fensom elevators of an improved type.

Mining Matters.

Norman Green, Gilmour, Ont., has been appointed manager of the Anglo-American Iron Company.

D. G. Kerr, manager of the Cordova Exploration Co., Hastings county, Ont., is buying a plant for the mine.

The Royal Oak Mining Company, of Goldenville, N.S., has ordered from a Nova Scotia house a 10-stamp mill.

The Dominion Iron and Steel Co., expects to ship about 500,000 tons of iron ore from Bell Island this summer.

A large deposit of magnetite is being opened up west of Marmora by A. W. Coe, of Madoc, Ont.

Some 50,000 tons of coal are imported from the United States into Mexico. Canadian mines on the Atlantic tidewater should surely be able to do this trade.

The gold mine at Rose Blanche is turning out so well that soon about 200 men will be employed there, says The Herald, St. John's, Nfld. A stamp mill has been ordered from London.

The Nova Scotia Gold Mining Co. property at Renfrew, N.S., has been sold to F. A. Jones, Hon. A. T. Dunn, J. Kennedy and A. Malcolm, St. John, N.B. The price was $37,500 for the mine and $6,000 for some adjoining areas.

C. A. Abbott, representing Fraser & Chalmers, is superintending the installing of the 10-stamp mill at the Glass Reef mine, Wabigoon, Ont. The tramway to the mill from the mine will be somewhat expensive. It is expected the whole plant will be in operation by September 1st.

A new stamp mill is to be put in this summer on the Cook mine (Dean & Williams), Deloro, Ont. This mine is just south of the other two Deloro stamp mills, and the three mills and arsenic mills altogether will make Deloro quite a famous mining place.

The copper deposits at New Annan and Cape d'Or, N.S., have come in for a large share of attention during the past few months at the hands of a number of New York persons who have organized a company as the Colonial Copper Co., J. A. Hanway, New York, president. It is said that the Canadian Rand Drill Co., Sherbrooke, Que., will equip the mine.

J. F. Richey, coal inspector for the Canadian Pacific Ry., was in Cape Breton recently in connection with the contract of that railway with the Dominion Coal Co., from which it has bought 250,000 tons of coal for delivery before the close of navigation.

Mining in the rear of Frontenac county, Ont., along the line of the Kingston & Pembroke Railway, is again becoming a prosperous industry. J. Kellendem, Milwaukee, will start two diamond drills on iron ore beds in this district. Operations have been resumed at the Boerth gold mines in the county of Addington, Ont.

Eastern Ontario can now boast of four stamp mills treating successfully gold ores which have been condemned as refractory. The mills aggregate 40 stamps and employ nearly 300 men in connection with the mines or mills. A fifth 10-stamp mill is in course of erection at the Diamond mine near Queensboro, which has developed during the last year from a prospect to a mine through the perseverance of D. E. K. Stewart, of Madoc.

A new mineral, believed to be of commercial value, has been discovered in the copper ore of Michigan, U.S., and has been named mohawkite, after the mine where it was found. Samples were submitted to Dr. Koenig, a metallurgist of Haughton, Mich. The first specimen was supposed to be a sulphuret of copper. As a rule, these sulphurets carry considerable quantities of antimony and arsenic, refractory elements which hinder smelting. Green carbonates of copper are of frequent occurrence in the lodes proper, especially near the surface. Chemical analysis of the Mohawk ore, which has been named mohawkite by Dr. Koenig, reveals an arsenide of copper, similar to the domeykite, in connection with which is also found an arsenide of nickel, the two metals being chemically, and not mechanically, united, in the embrace of the arsenic. The

mohawkite gives average assays of 61.7 per cent. of copper, 7 per cent. of nickel, 2.2 per cent. of cobalt, 28.8 per cent. of arsenic and 3 per cent. of iron. It is believed that this mineral will be valuable in the production of alloys. It can be heated with very little waste.

Railway Matters.

On the south side of Hillsboro, opposite Charlottetown, P.E.I., the first sod of the Belfast and Murray Harbor Branch Ry. was turned May 16th.

All the lines under construction in the Canadian Northwest by McKenzie & Mann are to be operated as the Canadian Northern Ry.

Application is being made by the Vancouver, Northern & Yukon Ry. Co. for an Act extending the time in which it may build, and to insert the word Westminster after Vancouver in the title of the company.

D. C. Fraser, Guysboro, N.S., solicitor for the British Yukon Railway Co., recently stated that the section of railway extending 100 miles, from Cariboo Crossing to the Lower White Horse Rapids, would be open for traffic by June 1. The line from Skaguay to Bennett is 40 miles long, and from thence a fine boat takes passengers to Cariboo Crossing 20 miles further, in connection with the railway that is now nearing completion. This last section of 100 miles has cost $2,000,000, and British capital has been employed to build it.

Personal.

C. F. Smith, manager of the Belleville, Ont., waterworks, is seriously ill.

Superintendent Charles Jolly, of the Guelph, Ont., Rolling Mills, has tendered his resignation, and will be succeeded by Mr. Stevenson.

W. A. McLeod, manager of the Stuart-Arbuthnot Machinery Co., Ltd., Winnipeg, was formerly manager for the Gilles Co. in Carleton Place, Ont.

W. A. Mackay, superintendent of the Reid electrical works, St. John's, Nfld., received serious injury to his right hand at the sub-station one day recently, it being badly burned.

J. A. Gunn, C.E., eldest son of Alexander Gunn, Kingston, Ont., and Miss M. A. Carr-Harris, daughter of R. Carr-Harris, C.E., of the Royal Military College, Kingston, Ont., were married at the British consulate, Alexandria, Egypt, a short time ago.

As the result of a boiler explosion in the shingle mill of F. James at Hobart, 15 miles from Orillia, Ont., F. James, son of the proprietor, was thrown a distance of 100 yards and instantly killed. Another son, A. James, was severely scalded by escaping steam.

The Gzowski medal for the best paper of the year, read before the Canadian Society of Civil Engineers, has been awarded to R. S. Lea, assistant professor of civil engineering, McGill University, for his paper on the "Sand Filtration of Public Water Supplies," which was published in The Canadian Engineer in five instalments last year.

At the Laurie Engine Works in Montreal last month a workman named E. Dubois was killed. He was standing near half of a large fly wheel, weighing four tons, on a truck, when an iron crowbar supporting one end of it broke, throwing the section on top of him, crushing him to death. The jury returned a verdict of accidental death.

Walker Alexander, late chief engineer of the Montreal street railway, was presented on leaving for Dublin, Ireland, where he is now chief engineer of the Dublin street railway, by the employees of the power house with a gold watch and chain as signalizing the esteem in which he is held by Montreal street railway operative department employees. Assistant Engineer Homes made the presentation.

D. Fowler, late of Waterous Engine Works, Brantford, Ont., has taken a position in the Waterloo, Ont., Mnfg. Co.

The death occurred, May 26th, of H. H. Fuller, head of the wholesale hardware firm of H. H. Fuller & Co., Halifax, Nova Scotia. He was 72 years of age.

H. L. Chipman, Halifax, N.S., has been appointed manager of the Plant Line of steamers. He will in future live in Boston.

J. B. Rankin, Chatham, N.B., has been appointed drainage referee for Ontario. B. M. Britton, Q.C., having resigned this position some time ago.

R. C. Pettigrew, president of Hamilton branch Can. Asso. Stationary Engineers, has been appointed to the board of management of the Hamilton, Ont., Art School.

Manzer Kitchen, aged 19, was caught between the main driving belt and the pulley in the Maritime sulphite fibre mill at Chatham, N. B., May 15th, and was instantly killed.

Robert W. Waddell has been appointed city engineer in Kansas City, U.S. He was born in Cobourg, Ont., and graduated from the Applied Science Faculty of McGill University, Montreal.

Michael Lambert, an employee of the Dominion Bridge Company, who was employed on the Inter-provincial bridge, Ottawa, fell a distance of 70 feet from one of the piers to a scow and was killed, May 23rd.

T. J. Craig, Kingston, Ont., has been appointed freight agent at Toronto for the Richelieu & Ontario Navigation Co., vice the late Peter McIntyre. He at one time was captain of the steamer "Passport."

J. R. O'Brien, Renfrew, Ont., has gone to the Rainy River country to assume the position of foreman of construction on the railways in that district which are being built by McKenzie & Mann. His headquarters will be at Port Arthur.

A. Blackwell, of Bryson, Que., was instantly killed in Savage & Cutter's sawmill at Cobden, Ont. He was pushing a truck loaded with lumber to the place in which it was to be piled, when by the truck leaving the track he was thrown 20 feet and fractured his skull.

George A. Keefer, C.E., Victoria, B.C., has been appointed resident engineer of the Dominion Government Public Works Department in British Columbia in place of J. R. Roy, C.E., recently appointed secretary of the department. Mr. Keefer has been a resident of British Columbia for thirty years, working on the C. P. R. during construction and afterwards being appointed inspector of bridges for the company. He came to Victoria in 1884, and opened an office, although he spent much of his time on the mainland carrying out a number of large works, including dykes and bridges.

J. L. Craig, Copper Cliff, Ont., assistant general manager of the Canadian Copper Co., died at his home there from heart disease, May 17th. He was born in Renfrewshire, Scotland, and was almost 54 years of age. He went to Glasgow when a young man and came to America about 25 years ago. Before coming to Ontario he held a position of trust for six years with the Nova Scotia Steel Co., New Glasgow, N.S., and resigned this to accept one with the Canadian Copper Co. in June, 1898, since which time he has been assistant to the general manager.

A young man named Jobin, employed on the transformation of the steam railway to La Bonne Ste. Anne into an electric railway, was killed, May 17th. While placing a span wire on one of the poles he came in contact with a live wire, receiving a shock of 2,000 volts, and remained suspended for several minutes until the wire was cut. He was brought down unconscious, with one arm and leg terribly burned and lacerated, and died shortly after.

Alex. Wilson, who recently left the employ of the Hamilton, Grimsby and Beamsville Ry. to be chief clerk at the Hamilton street railway office, was presented with a silk umbrella, gold-mounted and suitably inscribed, in recognition of the company's appreciation of his six years of faithful service on the H. G. & B. The presentation took place in the company's office, Vice President W. J. Harris making the presentation. President C. J. Myles, Treasurer R. S. Martin and Secretary-Manager A. J. Nelles were present.

Prof. A. P. Coleman, of the School of Practical Science, Toronto, geologist for the Ontario Government, has gone on a long trip to Northern Ontario. He will first go to report on placer mining at the head waters of Vermillion and Wahnapitae rivers. Then he will visit the Nipissing line, and explore the jasper belt, which is known to exist, and which is believed to extend from Lake Superior to Lake Temiscamingue. Iron ore is found with jasper in Minnesota and Wisconsin. In 1896 Mr. Burwash, who was with the Nipissing survey party, followed the belt for sixty-one miles.

It was rumored in McGill University, Montreal, that, owing to the change which is to be made in the chemistry department of the faculty of medicine at McGill University next year, Dr. Girdwood will resign as professor of chemistry at the close of the present session. It is stated that the conditions attached to Sir William Macdonald's recent gift of $100,000 to the department of chemistry at the university would probably necessitate some changes. Dr. Girdwood has been identified with the work of the faculty of medicine for many years past, and his retirement would be regarded as a great loss to that department of the university.

T. A. Dando, of Brantford, has taken a situation as traveling mechanical engineer for the Smart-Eby Company of Hamilton. The Brantford Expositor describing the farewell given him by his fellow-workers in the Canada Cycle and Motor Company's works said: "A very interesting event transpired yesterday afternoon at the works of the Canada Cycle & Motor Company, when over 300 of its employees assembled to express their deep regret at the departure for Hamilton of their former assistant superintendent, T. R. Dando. W. H. Shapley, of Toronto, general manager of the Cycle & Motor Company, was present, and in a neat speech presented Mr. Dando, on behalf of the men, with a handsome gold watch. W. J. Davies, chief accountant of the company, read the address, which was illuminated.

J. Duckworth, one of the oldest bridge inspectors in Canada, died recently at his home in St. Lambert, Que., at the age of 77 years. He was a native of Leeds, Eng., and came to Canada 45 years ago, and three years later entered the service of the Great Western line, as bridge inspector. After the completion of the line, he was brought down to Montreal in connection with the building of the Victoria tubular bridge, superintending the laying of the first crossplate of the first span of the old bridge, and remaining on duty until the construction of the bridge was completed. After that he was appointed general bridge inspector of the Grand Trunk Railway from Sarnia to Portland, serving under Walter Shanly, Mr. Brydges, E. P. Hannaford and Joseph Hobson, chief engineers. At the time of opening of the old Victoria bridge Mr. Duckworth assisted at the driving of the gold headed rivet in the centre tubular span by the Prince of Wales. He leaves a wife and four children—William Duckworth, Walter R. Duckworth, bridge inspector and tester of materials for the Dominion Bridge Company; Mrs. R. C. Morgan, wife of the general superintendent of the Arizona and Southeastern Railway, Bisbee, Arizona, and Miss Lilian Duckworth.

Brief, but Interesting.

At Westmount, Que., which is a part of Montreal, the authorities have been experimenting with coal oil as a preventive of dust on the public streets, as has been reported in The Daily Witness, Montreal. Western avenue was selected, and some one hundred yards treated with coal oil. The local authorities are disposed to regard the idea with favor, but adverse opinions are being freely expressed. In the first place, residents say that the smell is intolerable. A gentleman who has had many years' practical experience with roads and athletic grounds, and who has used both coal oil and salt and water for the purpose which is in the thought of the Westmount authorities, states through The Witness that he hoped the avenue would not be ruined by a continuation of the experiment. Coal oil, according to this gentleman, lays the dust, but apart from the smell, its effect is to disintegrate the roadway, leaving it porous and open, which is more objectionable than the dust. The oil seemed to eat into the surface, which it broke up, leaving large openings, which prevented the natural cohesion that the rain effects. On the other hand, salt and water was proved to have an excellent effect in laying the dust for several days, while it was innocuous, and simply gave the roadway a white appearance. Coal oil has been tried on several of the western railways, but has been largely abandoned, it is said, though upon the roadbed of a railway the effect would not be so serious as upon a macadamized road.

C. F. Burgess, in a paper read at the March meeting of the Chicago Electrical Association, referred to the desirability of an electroplating bath containing no water, which would obviate difficulties encountered in working with certain metals, owing to the presence of hydrogen released from the water, says The Electrical World and Engineer recently. Recent experimental research has shown, he says, that it is possible to dissolve certain metallic compounds in certain organic substances, and that such solutions may be electrolytes. Some notable work along this line has been carried on very recently by Dr. L. Kahlenberg, of the University of Wisconsin. He has succeeded in obtaining very good deposits of lithium, a metal which under ordinary circumstances would be considered even more difficult to deposit than aluminum or magnesium. His method consisted in dissolving lithium chloride in pyridine, a somewhat volatile organic compound, and passing the current through the solution, as in the ordinary plating operation.

The use of automatic acetylene gas generators does not meet with the approval of the Engineer, London. In a recent article it regrets that non-automatic generators are so rare. The chief objection urged to the automatic generator is the necessity of a safety valve, which causes loss of gas and thus increases the cost of operation. Some untrue statements made by the makers of acetylene apparatus are commented on, such as that ceilings are not discolored by acetylene and that it gives sixteen times as much light as coal gas. The facts being that ceilings are discolored by the dust suspended in the air being carried up by the heated air, and deposited on the roughnesses of the ceiling, not by carbon from the flame. The ceiling over an incandescent electric lamp will become discolored in time, but it is necessarily slow, as the amount of heat is slight. The same decolorization takes place on walls beside which steam or hot water radiators are placed if the wall surface is not very smooth. Coal gas is, of course, vastly inferior to acetylene in illuminating power, volume for volume, but if both are burned in an incandescent burner the difference will be vastly reduced, if not abolished, because acetylene, as it is lower in heat producing power, gives less light than coal gas in an incandescent burner.

Prof. Busley, who is at the head of the newly formed Schiffbautenische Gesellschaft, a German naval constructors' institution, made a speech on submarine boats at the opening of the Gesellschaft, which brings forward some interesting points. Among inherent difficulties in constructing submarine boats, Engineering, London, reports that Prof. Busley placed first the low stability of these craft. Tranverse stability and prevention of rolling may be secured. The chief trouble is the tendency to pitching. A man walking forward in the boat will send her nose down, and as no boat has been yet built to withstand the pressure below 100 feet depth, this is a grave charge in case the steering apparatus should fail to bring the boat immediately up. This danger is enhanced by the fact that the horizontal helms are slowly responded to. The extremely limited range of sight under water is a further obstacle to the successful general employment of these boats as engines of war. Light emanating from a focus under water will at a distance of 100 yards have less than one ten-millionth of its illuminating power, and it must be remembered that searchlights could not be used, as they would betray the whereabouts of the submarine boat. On a clear day a diver 20 feet below the surface can hardly see more than 25 feet into the water. This means that a submarine boat must approach an enemy very closely to attack, and hence would have a small chance of escaping unharmed. The speed of the boat recently launched in France is kept below eight knots by the weight of the storage batteries, which for a journey of six hours is about six cwt. per indicated horse power. The conclusion drawn is against the submarine boat as at present built as a means of attacking a floating navy.

SCHOOL OF PRACTICAL SCIENCE, TORONTO.

The results of the recent examinations at the School of Practical Science, Toronto, were published last month. The class of mining increases in size every year. The results are as follows:

Department of Civil Engineering.—Honors—First Year—W. E. Costin, T. S. Nash, G. G. Powell. Second Year—H. P. Rust, Third Year—E. H. Phillips.

Pass—First Year—P. G. R. Alison, J. W. Blair, A. R. Campbell, W. E. Douglas, A. E. Gibson, W. A. Gourlay, J. J. Mackay, F. Moore, R. W. Morley, W. F. Ratz, D. F. Robertson. Second Year—R. H. Barrett, W. A. Duff, L. Gagne, C. Harvey, G. McMillan. Third Year—J. L. Allan, L. T. Bray, A. Taylor, W. C. Tennant, F. W. Thorold, H. M. Weir.

Department of Mining Engineering.—Honors—First Year—W. Christie. Second Year—D. E. Eason, D. L. H. Forbes. Third Year—M. C. Boswell, H. A. Dixon, J. A. Johnston.

Pass.—First Year—W. Campbell, F. T. Conlon, M. T. Culbert, R. Cumming, W. M. Edwards, J. M. Empey, A. J. Isbester, T. J. Steele, C. Teasdale. Second Year—A. T. F. Hamer (aegrot.), F. C. Jackson, J. L. R. Parsons. Third Year—E. G. R. Ardagh, J. E. Davison, C. H. Fullerton, H. S. Holcroft, R. E. McArthur, J. G. McMillan, E. V. Neelands, J. R. Roaf, H. W. Saunders, S. M. Thorne.

Mechanical and Electrical Engineering.—Honors—First Year—H. J. Barber, R. J. Dunlop, C. Henwood, P. Mathison, C. H. Marrs, H. L. Seymour, D. Sinclair, T. Taylor. Second Year—G. M. Bertram, W. P. Brereton, A. Laidlaw, H. G. McVean, H. W. Price. Third Year—C. H. E. Rounthwaite.

Scenes in the Hull Fire.
From photo by John McLeish of the Geological Survey, Ottawa.

Pass.—First Year—J. Breslove, J. M. Brown, V. H. Connor, T. E. Corrigan, W. Elwell, V. C. Goodwin, J. G. Hutchison, D. M. Johnston, A. G. Lang, A. H. McBride, J. T. Mackay, J. F. C. Madden, H. D. Robertson, J. E. Roy, A. V. Wanless, J. G. Whelihan. Second Year—W. G. Beatty, W. J. Bowers, E. J. Brandon, J. T. Broughton, C. G. Carmichael, W. G. Chase (aegrot.), A. G. Christie, N. Clarke, J. R. Cockburn, N. R. Gibson, A. C. Macdougall, G. C. McCollum, A. T. McMaster, H. T. Middleton, M. V. Sauer, W. H. Stevenson. Third Year—J. V. Bain, J. H. Burley, J. Clark, E. D. Dickinson, G. W. Dickson, W. S. Guest, W. Hemphill, S. E. M. Henderson, J. A. Henry, H. A. Johnston, J. C. Johnston, L. H. Miller, F. D. Withrow.

Department of Architecture.—Honors—Second Year—W. F. Shepherd.

Department of Analytical and Applied Chemistry.—Pass—First Year—F. L. Langmuir.

Certificate in Mineralogy and Assaying—A. H. Smith.

Civil Engineering.—Prizemen.—Prizeman—Third Year—Civil Engineering—F. H. Phillips. The prize in civil engineering is the gift of T. K. Thomson, C.E., New York.

—The Jones & Moore Electric Co. has recently sold, among others, the following:

J. J. Sadler, 4-h.p. motor, Vancouver, B.C.
Millar & Richard, 2-h.p. motor, Toronto.
T. Tomlinson & Son, 20-h.p. motor, Toronto.
Bertram Engine Works, 20-h.p. motor, Toronto.
Queen City Carpet Co., 12-h.p. motor, Toronto.
Toronto Fence and Iron Co., 20-h.p. motor, Toronto.
T. Smith & Co., 6-h.p. motor, Toronto.
J. Whitfield & Co., 10-h.p. motor, Toronto.
J. Shales, 6-h.p. motor, Toronto.
J. Hamilton, 2-h.p. motor, Toronto.
National Stereotype Co., 10-h.p. motor, Toronto.
A. Jackman, 2-h.p. motor, Toronto.
Harrison & Co., 6-h.p. motor, Winnipeg.
J. Shipton, 4-h.p. motor, Vancouver, B.C.

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

The Ontario Association Stationary Engineers held its annual convention at London, Ont., May 28th, at which there was a good representation from among the certificate holders from the various cities and towns throughout Ontario. The report of the registrar as to membership showed 917 as the total upon the books, of which 13 have died, 8 are blank members, and 154 have been cancelled, leaving 742 members in good standing. The financial statement of the treasurer showed an income, including the balance from last year, of $653.99, and an expenditure of $517.89, leaving a balance on hand of $136.10. A full discussion of the license law and the prospect of having it passed brought out the fact that many steam users who were at one time opposed to the measure, have now become favorable

Scenes in the Hull Fire.
From photos by John McLeish of the Geological Survey, Ottawa.

to it, and a committee was appointed to further enlighten the steam users, personally, as to the working of the proposed act. The election to fill the places of the retiring members of the board resulted in the election of O. P. St. John, Toronto; A. E. Edkins, Toronto; A. M. Wickens, Toronto, and Alex. Findlay, London. The board then elected the officers as follows: O. P. St. John, president; Thos. Elliott, Hamilton, Ont., vice-president; J. G. Bain, 113 Yorkville avenue, Toronto, as registrar; and A. M. Wickens, Toronto, treasurer. A lively election occurred for the next place of meeting, St. Thomas, Paris, Brantford and Berlin all being nominated, the ballot being in favor of Berlin. The usual complimentary votes to the officers then passed, and the meeting closed.

DRAIN PIPE FOR RAILWAY CULVERTS.

A United States subscriber enquires as to the best practice for setting cast iron drain pipe for railway culverts, and the thickness of pipe to be used. In reply to the last part of the question, the following may be safely adopted as to thickness of pipes: $\frac{3}{4}$ inch thickness for 12 inch pipe, $\frac{7}{8}$-inch for 18 inch pipe, 1 inch for 2 ft. pipe, $1\frac{1}{4}$ inch for 3 ft. pipe and $1\frac{1}{2}$ inch

for 4 ft. pipe. As to setting, if the foundation is good they may be laid in a semi-cylindrical trench, but if not they should be laid in cement, a bottom of cement being first laid, and when the pipe is laid the space on each side of pipe to be filled in with cement and well packed around it. Head walls may be omitted, except for appearance, but an apron wall, to cut off underflow, is necessary at each end. For other information as to laying pipes for culverts, etc., see pages 78, 79 and 80 of Prof. C. B. Smith's "Railway Engineering," which may be obtained through this office.

THE PRACTICAL MAN.

TABLE OF STANDARD DIMENSIONS OF WROUGHT IRON WELDED PIPES.

Nominal Diameter.	External Diameter.	Thickness.	Internal Diameter.	Internal Circum.	External Circum.	Length per sq. ft. of internal surface.	Length per sq. ft. of external surface.	Internal Area.	Weight per Foot.	No. of Threads per inch of Screw.
In.	In.	In.	In.	In.	In.	Feet.	Feet.	In.	Lbs.	
1/8	.40	.068	.27	.85	1.27	14.15	9.44	.057	.24	27
1/4	.54	.088	.36	1.14	1.7	10.5	7.075	.104	.42	18
3/8	.67	.091	.49	1.55	2.12	7.67	5.657	.192	.56	18
1/2	.84	.109	.62	1.96	2.65	6.13	4.502	.305	.84	14
3/4	1.05	.113	.82	2.59	3.3	4.64	3.637	.533	1.13	14
1	1.31	.134	1.05	3.29	4.13	3.66	2.903	.863	1.67	11½
1¼	1.66	.14	1.38	4.33	5.21	2.77	2.301	1.496	2.26	11½
1½	1.9	.145	1.61	5.06	5.97	2.37	2.01	2.038	2.69	11½
2	2.37	.154	2.07	6.49	7.46	1.85	1.611	3.355	3.67	11½
2½	2.87	.204	2.47	7.75	9.03	1.55	1.328	4.783	5.77	8
3	3.5	.217	3.07	9.64	11.	1.24	1.091	7.388	7.55	8
3½	4.	.226	3.55	11.15	12.57	1.08	0.955	9.887	9.05	8
4	4.5	.237	4.03	12.65	14.14	.95	0.849	12.73	10.73	8
4½	5.	.247	4.51	14.15	15.71	.85	0.765	15.939	12.49	8
5	5.56	.259	5.04	15.85	17.47	.78	0.629	19.99	14.56	8
6	6.62	.28	6.06	19.05	20.81	.63	0.577	28.889	18.77	8
7	7.62	.301	7.02	22.06	23.95	.54	0.505	38.737	23.41	8
8	8.62	.322	7.98	25.08	27.1	.48	0.444	50.039	28.35	8
9	9.69	.344	9.	28.28	30.43	.42	0.394	63.633	34.08	8
10	10.75	.366	10.02	31.47	33.77	.38	0.355	78.838	40.64	8

THE CRAMP ONTARIO STEEL CO., LTD.

The Cramp Ontario Steel Company, Ltd., whose incorporation is mentioned in another column, has among the incorporators, C. D. Cramp and Wm. M. Cramp, late of the Wm. Cramp & Sons Shipbuilding Co., of Philadelphia, Pa. This is the company that has been formed for the purpose of erecting a blast furnace and steel works at Collingwood, and to whom the corporation granted a cash bonus of $115,000 and a free site of 50 acres on the harbor, together with other privileges. The promoters of the company state that arrangements have been made in the United States for the required capital for the company and that work will be pushed during the summer. The plant will consist of a blast furnace of 250 tons daily capacity, casting machines, three 30-ton open-hearth furnaces, to be operated on the basic system; also a blooming mill and a rolling mill capable of producing steel rails, structural steel for buildings and ship-building purposes, and steel sheets for ship-building, bridges and tank and boiler purposes. The company will also produce, it is said, nickel steel ingots and castings. The company has secured a promise of sufficient first-class Ontario iron ore to keep them in operation for five years. The company will operate its plant on the continuous system, by which a great economy in fuel will be effected. It is understood that the company is securing 5,000 acres of coal lands in the coking region of Pennsylvania and West Virginia for the manufacture of coke, so as to be independent of the United States combines with respect of fuel. The town of Collingwood was chosen by the company largely for the purpose of obviating the canal tolls on the ore from Lake Superior and fuel from Ohio to any point on Lake Ontario, which alone would have amounted to something like $80,000 per year, the company states.

IMPERIAL TRADE NOTES.

A well-known firm of safe manufacturers in England wants a Canadian representative.

The owner of extensive mica deposits in Canada wants to negotiate for sale to British firms.

A London agency firm wants to represent Canadian iron and steel makers, paper and pulp makers, etc.

Some makers in Canada of bath rims, closet seats, tanks, etc., wish to make trade connections in Great Britain.

A hardware firm in London, Eng., desires to form a connection with metal and hardware importers in Canada.

A Scottish inventor wants to sell the Canadian rights to a machine to turn peat into hard condensed blocks ten hours after digging, also into charcoal.

An English firm wants to correspond with Canadian makers of "3-ply hardwood," i.e., one thick and two thin veneers cemented together, also makers of spruce wood boxes in large quantities.

A manufacturer of magnesite and magnesite bricks in Coblentz, Germany, wants the names of Canadian steel and nickel producers who would likely use magnesite for lining open hearth furnaces, etc.

There has been an enquiry from Copenhagen, Denmark, for the names of people who would be likely to take up a new process of making cement pipes for sewers, etc., to take the place of glazed earthenware pipes.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trades to Canada from Great Britain for April, 1890-1900 and the four months including April, 1899-1900.

	Month of April.		Four months including April.	
	1899	1900.	1899.	1900.
Cutlery	£4,450	£4,802	£15 638	£17,725
Hardware	1,913	1,859	6,300	9,375
Pig iron	938	3,619	1,984	12,396
Bar, etc.	581	2,775	2,372	7,513
Railroad	149	69	149	390
Hoops, sheets, etc.	2,615	8,453	6,645	12,377
Galvanized sheets	3,930	4,920	5,511	16,025
Tin plates	11,792	33,205	32,997	93,827
Cast, wrought, &c., iron	1,713	5,680	6,057	18,730
Old (for remanufacture)	136	1,305	136	8,388
Steel	3,516	18,025	11,979	90,726
Lead	5,238	1,470	7,765	6,578
Tin, unwrought	697	3,819	5,604	12,976
Alkali	2,326	4,997	6,646	12,222
Cement	3,573	3,273	4,329	6,981

LITERARY NOTES.

The annual report of the city engineer of Halifax, N. S., for 1898-99, is before us by kindness of F. W. W. Doane, city engineer, we are also indebted to him for the Annual Reports of the general Departments of the Civic Government of Halifax, N.S., which includes the report of the city engineer for 1897-98.

There has recently been issued from the Mining Reporter Press, Denver, Col., Sullivan's New Hydraulics, consisting of New Hydraulic Formulæ and the Rational Law of Variation of Coefficients. Among subjects taken up are: Flow and resistance to flow in all classes of rivers, canals, flumes, aqueducts, sewers, pipes, fire hose, hydraulic giants, power mains, nozzles, reducers, etc., with extensive data of cost of pipes and trenching, and pipe line construction.

Canada's Transportation Problem from a National Standpoint is the title of a pamphlet issued by the Board of Trade of the City of Toronto. The sub-title, the Short Line Railway over the Portage from Toronto to Georgian Bay gives a more accur-

ate idea of the contents. A large inset map shows the situation of the various routes. The whole is an able plea for a Government railway to bring trade to Toronto, which is discriminated against, it is thought, by both the C.P.R. and the G.T.R.

Mechanical Ventilation and Heating by a Forced Circulation of Warm Air, is the title of a lecture delivered by Walter B. Snow, before Sibley College, Cornell University, a short time ago. The lecture has been issued by Mr. Snow in pamphlet form

We have received a copy of the sixth edition of a practical treatise on Gearing, published by the Brown & Sharp Mnfg. Co., Providence, R.I. This is a book made for men in practical life; for those who would like to know how to make gear wheels, but whose duties do not allow them leisure to acquire a technical knowledge of the subject. It is divided into two parts of twelve chapters each. To chapter VII. of part II. we would call particular attention, "Cutting Spiral Gears in a Universal Milling Machine." This is entirely new and adds much to the attractiveness and value of the book.

The April number of the Imperial and Asiatic Quarterly Review (published by the Oriental University Institute, Woking, Eng.), contains, besides a thoughtful article on the South African question, a striking paper on Imperial problems, by C. de Thierry. Under the title of "Colonial Sovereignty," the writer proves that the spirit of imperialism is possessed by people of the British colonies as strongly as by people of the British Isles. He takes the history of the leading British colonies such as Canada, the Cape, Natal, New Zealand, New South Wales, and other Australian colonies, and shows how they have taken under their jurisdiction adjoining territories and islands, some of the latter being several hundred miles from their borders. He pays a fine tribute to the courage and breadth of view of Canadian statesmen, the prescience of Sir John Macdonald being especially recognized. Pointing out the fact that it is due to Ottawa and not to London that Great Britain now has a Pacific seaboard in America, and a quick route to the East, he says: "In this, as in nearly all the important steps made by the Anglo-Saxon world towards union, the Dominion led the way. Even before the Act of 1840 past glimmerings of her splendid destiny lit up the darkness of that critical time, and her prophetic sons saw here the power in the British Empire she has since become. But it was not until the confederation of the Maritime Provinces and the Canadas that her future course marked itself out clearly before her." He then shows that Sir John saw more in the acquisition of the Hudson Bay Territory and British Columbia than the extension of a farming or mining area. After pointing out the difficulties under which the expansion of this country was accomplished he goes on to say, "The Dominion, though she had only just begun to awaken to the call of a national life, had in the storm and stress of nearly three centuries, developed those qualities which are essential to a ruling race—self-reliance, patience, dignity and a strong sense of justice." He then takes up the growth of imperialism in the other colonies, and makes it clear that in many cases the empire has grown by the force of public opinion in the colonies rather than by imperialism in the British Isles.

In reading "The English in Africa," by Hon David Mills, just published by Geo. N. Morang & Co., Toronto, every true Canadian must feel a glow of pride in realizing that Canada is slowly developing a type of public men whose mental horizon is not bounded by parish politics. We are gradually rising to the British conception of what a politician should be. The Hon. Mr. Mills has studied African problems to good purpose, and has given us what may be regarded as a text book on African politics. In this volume of 371 pages, there are chapters on the history of British dealings with Egypt, with the Soudan, with West Africa, with East Africa, with South Africa and Rhodesia. The South African question naturally occupies the chief place, and the writer—whose knowledge of constitutional questions is not surpassed by any Canadian—completely vindicates the legal as well as the moral position of Great Britain in her dealings with the Transvaal. In some minor points of geography and nomenclature, Mr. Mills is occasionally astray but he has grasped the main problems with a judicial instinct, and lays clearly before the reader a panorama of the Boer and British policy in South Africa Dealing with the history of the Transvaal since it was delivered over to Boer rule by Mr. Gladstone, he says: "It is doubtful whether there is another instance in history where any other subjugated people have assumed so arrogant a tone towards those who were their conquerors. In the Transvaal, at the breaking out of the war, the Boers were not more than one-third of the white population. With a fair electoral system they would have been in a hopeless minority. Their system of Government would have been brushed away, and the direction of affairs would have been in other hands. They armed themselves; they disarmed others. They imposed tremendous burdens upon the majority, in order to collect arms and munitions of war to perpetuate their political supremacy and to maintain these political advantages of which by fraud and bad faith they have become possessed. That is not peace; it is conquest. It is supremacy by treachery and by force of arms, maintained by the tribute imposed upon the disfranchized. It is preposterous to call such a Government a Republic. It is a tyrannical oligarchy."

The Educational Review is now publishing a valuable series of leaflets dealing with special features and epochs of Canadian history. Such writers as Sir John Bourinot, Prof. W. F. Ganong and Col. Cruickshank are contributors, and these leaflets will be a most useful means of educating people on many more or less obscure points of Canadian history. The price is very low, being 10 cents per copy, or $1 for the series of 12 leaflets. Address Geo. M. Hay, Educational Review, St. John, N.B.

NEW CATALOGUES.

In a 40-page 6 x 9 catalogue, beautifully illustrated and printed on fine paper, the Diamond Machine and Screw Co., Toronto, show a partial list of the goods made by them. It manufactures in addition to the standard iron and steel set screws, square, hexagon, round, flat, button and fillister head cap screws, taper pins, nuts of all sizes and the different finishers, boiler patch, planer, studding and milled coupling bolts, washers, thumb screws and machine screws, are prepared to figure on special screw and machine works, and have one of the best equipped machine shop plants in Canada, which is under the care of experts in machine shop practice, whose experience has been gained in the leading establishments in Great Britain and the United States. The machinery builder, the dealer in supplies, and the hardware trade will find this catalogue useful also for its list of standard sizes and prices, and it will be sent on receipt of enquiry.

CORROSION AND FAILURE OF PROPELLER SHAFTS

At the last meeting of the Institution of Naval Architects in London, England, a paper on Corrosion and Failure of Propeller Shafts was read by A. Scott Young, B.Sc. He had his attention called to the frequent fractures of tail-end shafts, many of which had resulted in disastrous loss of property and still more lamentable loss of life. It could hardly be doubted that these shaft failures of late years had been on the increase. That this was widely recognized was evident by the amount of attention the subject had received on all hands. A list had been published of 83 casualties which occurred to the shafts and propellers of classed vessels during the months of January to July (inclusive), 1899. On analyzing these cases it seemed that 10 per cent. of them were accidents to propeller only, due to grounding and other obvious reasons. Of the remainder it appeared that accidents to propeller shafts were 50 per cent. more numerous than those of all other kinds of shafting taken together. According to a well known shipping paper there were in 1899 nearly 250 cases of accidents to the shafting and propellers of steamers of all nationalities. The particulars of these were not given with the same exactitude as those already mentioned, so that a similar analysis was impossible; but, assuming the same proportions be observed, it would appear that about 135 of these must be failures of tail end shafts. In addition to these, it was well known that during the year a very large number of propeller shafts were condemned when under survey; but in the absence of data no useful estimate of the number could be made Enough had been said, however, to show that the evil was one of wide and far reaching import

The Canadian Engineer

VOL. VIII.—No. 3. TORONTO AND MONTREAL, JULY, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,

E. B. BIGGAR. R. R. SAMUEL.

TRAVELING REPRESENTATIVE: A. W. SMITH.

PHILADELPHIA AGENT: H. E. BURNETTE, 2036 N. 13th Street.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

Bank of Toronto	58	Industrial Notes	68
Brief but Interesting	64	Literary Notes	57
Cable, Armored	53	Marine News	64
Canadian Copper Co., The	47	Marien, L. J., C.E.	54
Catalogues, New	59	Mining Matters	66
Cast Iron Pipe per foot in Pounds, Weight of	54	Nail Industry, The Wire	54
Chain Cables, Wrought Iron	54	New Ontario, Exploring	60
Chausse, Joseph Alcide	60	Patent Act, Proposed Amendments to the	45
Chucks, Auto-Reverse Tapping	56	Personal	65
Draining, Improvements in Private	50	Petroleum in Gaspe, Que.	52
Dynamo, Reversing a	48	Power Plant at Orillia, The	56
Electric Flashes	64	Press in Reduction Works, Filter	57
Engineer, The Master Spirit of the Age, The	55	Public Works	61
Engineers' Club of Toronto	60	Railway Matters	64
Estimates, Supplementary	61	Standard Oil Co.	54
Geological Survey Department Report, The	47	Stationary Engineers, Canadian Association of	60
Hamilton Steel & Iron Company, at Hamilton, Ont, The New Steel Plant of the	46	Toronto Harbor	52
Imperial Trade Notes	60	Ventilating Fan, A new Type of Electric Propeller	50
		Ventilation and Heating	48

PROPOSED AMENDMENTS TO THE PATENT ACT.

There is now before a committee of the House a proposal to amend section 8 of the Patent Act by striking out the following words from the section: "And under any circumstnaces, if a foreign patent exists, the Canadian patent shall expire at the earliest date on which any foreign patent for the same invention expires." This amendment to the section is a very necessary one. The primary object of the provision, no doubt, was to insure that a foreigner should duly apply for letters patent in Canada promptly. We have another section in our Act in which there is provision that application must be made within one year from the date of the foreign patent. This latter provision covers all that is necessary, and the provision in section 8, which it is proposed to strike out, is superfluous and dangerous in its character.

As matters now stand, and as recently decided by Burbidge, J., in the Exchequer Court of Canada in the General Engineering Co., of Ontario, Ltd., vs. the Dominion Cotton Mills Co., and the American Stoker Co., a very valuable patent was declared void under this provision in section 8. In the case in question, British, Italian, and Canadian patents had all been filed on the same day, but as it turned out, the British patent was allowed to lapse after four years, and the Italian patent in about six years after the date of filing. As the Canadian patent was not issued until the 15th October, 1892, some three or four months after the dates of the issue of the British and Italian letters patent, the Canadian patent was declared void under the provisions of this section which it is now proposed to eliminate. In this case, the Canadian patentee has been put under disabilities, because he chose to apply for foreign letters patent. If he had never applied for foreign letters patent and the matter was free and open as to the foreign countries, he would not have been under any disabilities in Canada. The patent question in this suit involves a sum of over $100,000, and it was owing to this decision that a recommendation came from the Exchequer Court of Canada to have this dangerous clause struck out. Notwithstanding these facts, one of our legislators, to whom the matter has been referred in committee, objects strongly to the excision of this provision, which does not exist in either the British or United States Patent Acts.

There are several amendments to the Act, which are even more urgently required than the one in question, and some hopes were held out that this session would see changes for the better in our Patent Act, but owing to the ignorance of members of the committee, before whom the matter comes up, it seems almost impossible to get rational amendments to the Act made. There was also an amendment, included in the draft bill, to lengthen the term of a patent beyond the eighteen years already provided for, through the medium of a reference to the Exchequer Court of Canada. Members of the committee very properly take exception to this provision, as it is apparently the work of some person or company who have letters patent the monopoly of which they desire to continue. Except some few interested parties, no person is calling for such an extension.

There is a further amendment proposed to section 73 of the Act, relating to manufacture and importation of patented articles; in which it is provided that when there is a dispute as to what constitutes a "reasonable price" at which the patented articles shall be sold, it is to be settled by the Exchequer Court of Canada. In the section, as it now stands, although there is provision that the article should be sold at a "reasonable price," the question is entirely open as to any method of arriving at such conclusion. There would obviously be a vast difference of opinion between the owner of a patent and the person who desired to buy or use the patented article as to a "reasonable price," and it is proposed to make the Exchequer Court of Canada the tribunal to determine as to a reasonable price, which when fixed is to remain in force for the duration of the patent unless after three years another application is made to fix such reasonable price again. Provision is also made for further applications from time to time, after the expiration of any period of three years for a revision of what has been termed a "reasonable price."

THE NEW STEEL PLANT OF THE HAMILTON STEEL AND IRON CO., AT HAMILTON, ONT.

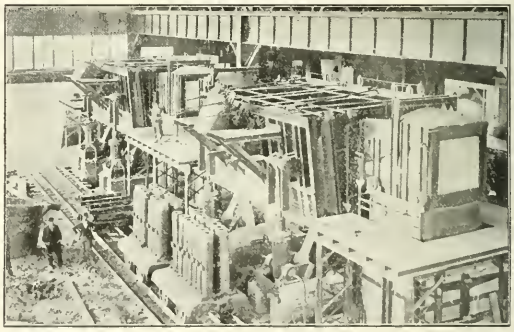
BY CLIFFORD C. SMITH, ENGINEER IN CHARGE OF CONSTRUCTION.

The first steel plant in Ontario was started about the first of June, 1900. This plant marks an era in steel-making in Canada, and in some respects in the United States also. The idea has been the development and successful operation of a plant for the casting and rolling of small ingots, a method of working which has often been tried, but which has hitherto been found a

very difficult thing to do. This plant, while not a large one, is in every way in accordance with the latest modern practice. It consists of a blast furnace, 17 feet by 75 feet, originally owned by the Hamilton Blast Furnace Co.; an open hearth plant containing two 15-ton Wellman rolling open hearth furnaces, with four 10 feet Talbot water sealed gas producers; a rolling mill containing one 14-inch and one 10-inch train for rolling merchant bar, small angles, and agricultural shapes. This plant is located on Hamilton Bay, on the east side of Hamilton, and just outside the city limits. The connection of the yard track system with both the Grand Trunk and the C.P.R. lines gives exceptionally good railroad facilities. There is also a pier which

extends out into the bay far enough to accommodate vessels of 14 feet draught, so that it will be seen that the best possible facilities are at hand for receiving and shipping large quantities of heavy materials.

The open hearth plant was designed and built throughout by The Wellman-Seaver Engineering Co., of Cleveland, Ohio. The buildings are of steel covered with corrugated iron. The main roof has a clear span of 54 feet and is about 150 feet long. The roof over the furnaces and charging floor has a span of about 30 feet. In this building there is a 25-ton travelling crane of 50 ft. span, built by the Shaw Electric Crane Co., Muskegon, Mich., designed to act either as a ladle crane or for handling ingots and ingot moulds. There is shortly to be installed, in addition, a small five-ton crane for handling ingots and ingot moulds exclusively. The Wellman-Seaver electric charging machine, used in connection with these furnaces is of the high type, similar to those now in use in all parts of the country. The power for all electric machinery is supplied from the blast furnace power-house, where two 100 h.p. Ideal engines and general electric generators are installed. This furnishes a 220 volt current for both power and lighting circuits, which is transmitted a distance of 1,000 feet to the open hearth plant. The different circuits are controlled from a switchboard in the power-house. The gas producer house contains four 10-foot Talbot gas producers. The coal for these producers is delivered in hopper bottom cars on an elevated trestle, and delivered

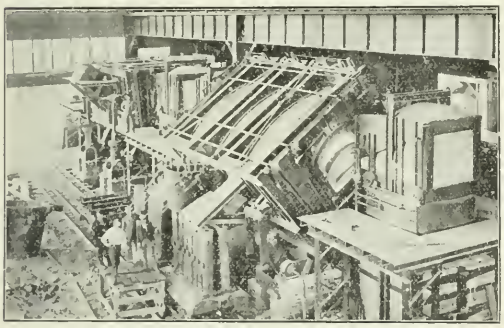


to the floor of the gas-producing building, thus insuring a minimum amount of handling. The producers are designed to overcome the difficulties which have been encountered in the use of grates in gas producers, and are water sealed at the bottom, the entire contents of the producer resting in the circular ash pan, which is made about 18 inches deep, and is filled with water. Large clinkers can be easily removed from under the producers, and at the same time a perfect joint is always maintained at the bottom. The blast is produced by steam jet acting in an Eynon injector, and the air blast is delivered in a 12-inch pipe to the centre of the producer, about two feet above the water line. The gas is conveyed through downcomers to end of main flues, and passes into the furnace through reversing valves of the Porter type.

Ample room has been left at the west side of the open hearth building for a stockyard to contain necessary raw materials; these are either brought in by railroad and stored in the yard, or brought over from the blast furnace, as required. The track system in this yard is so laid out that every part is accessible at all times, and it is impossible to block the yard even when the plant is running at its fullest capacity. The materials from this yard are loaded into special steel

boxes, which rest on iron cars, four on a car. These are taken up an incline to the charging floor of the open hearth building by a locomotive. Here they are weighed and set in front of the furnace doors. The electric charging machine then picks these boxes off the cars and empties them into the furnaces, returning the empty boxes back to the cars, which are then returned to the stockyard to be refilled.

The special features of these furnaces, to which we wish to call attention are, the removable port ends, which allow the substitution of newly-lined ports without materially interrupting the running of the furnaces, and the forehearth, which is also a recent innovation in open hearth practice, and in this plant has entirely superseded the use of the ladle, except for steel casting work, which will be undertaken in the near future. The forehearth in this plant contains two stoppers, and the pouring is done directly into ingot moulds, which stand on the cars in two rows under the nozzles of the forehearth, and are moved along by power. The ingots



are six inches square, and about five and a half feet long. They are poured "bottom cast," and the bottom runner is utilized as an ingot, by means of which all scrap, heretofore lost in the runners, is eliminated, and the entire pour can be run through the rolls. By making these ingots "bottom cast," an advantage is also gained over making them "top cast," because it is only necessary to move and set the ingot mould cars three times to pour an entire set of sixty-six ingots, a decided advantage in case of a defective stopper and a great saving of time in pouring the heat, for in case of top pouring, there would need to be thirty-three changes of position of ingot mould cars to pour these same ingots. The vertical ingots are separated from the horizontal ingots by small bricks one inch thick, which are let into the top of the bottom mould casting. These have holes under each mould to allow steel to come up from below. When the ingot moulds are raised off from the ingots the short sprues between the vertical and horizontal ingots are easily broken off, and the ingot moulds are placed at once on another set of cars ready for the next pour. The ingots are loaded while hot with only one handling, and are either shipped away or sent over to the heating furnace at the rolling mill. These ingots when broken have been found to be perfectly sound; they are easily stripped, and are admirably suited for rolling into bar iron or small shapes.

The success of casting small ingots depends on a quick method of casting. With the use of a ladle, the trouble has been to get the steel hot enough to pour so many ingots without having a large percentage of scrap from the chilling of the metal in the ladle, and heretofore when bottom casting of small ingots has been tried, there has been an excessive percentage of scrap owing to the runners in the group plate. By the use of the rolling furnace and forehearth, combined with a method of casting very quickly, and without having any scrap whatever in the group plate, a new method of handling steel has been inaugurated, which will at once recommend itself for a large number of uses where small sizes and shapes of rolled steel are required.

INTO THREE PARTS.

We remember from our youth, that "All Gaul is divided into three parts," and all our life long we have been accustomed to dividing and counting, so that we approach with interest, almost of a scientific kind, the study of the various spheres in which shine the talents of our confrere, the editor of the Canadian Mining Review. We referred in our last issue to the fact that some strictures, passed upon the Ontario Government by the Ontario Mining Protective Association, were being franked through the mails from the Dominion House of Commons. We have received the following letter on the subject:

CANADIAN MINING INSTITUTE, 1898.
(Incorporated by Act of Parliament).
Secretary's Office, Ottawa, 12th June, 1900.

Editor CANADIAN ENGINEER :

SIR,—Referring to your article published on page 29 of the June issue of the Canadian Engineer, entitled "Imported Impudence," permit me to say that all copies referred to were issued from my office, and the postage on each copy paid for. You will therefore withdraw in your next issue the impertinent imputation that our association was fraudulently using the mails. You will also be kind enough to state that the Canadian Copper Company is not a member of the Ontario Mining Protective Association, and was in no way responsible, directly or indirectly, for its publication. I am, yours truly,

B. T. A. BELL,
Secretary Ontario Mining Protective Association.

To this we have to say that we have no doubt the publication came from Mr. Bell's office. A commodious place, that office, to judge from this letter; the Canadian Mining Institute, the Ontario Mining Protective Association and the Canadian Mining Review, but not, certainly not, the Canadian Copper Co., inhabit it. We stated that last month. Mr. Bell says postage was paid upon the pamphlets he sent out, and we believe him. We can only say that a copy reached us franked from the Dominion House of Commons. As to what the Canadian Copper Co. is a member of in Canada, we will not venture to state. In the past we have at times been ready to believe it was a member of the Government.

THE GEOLOGICAL SURVEY DEPARTMENT REPORT.

We have at long last received the summary report of the Geological Survey Department, Ottawa, for the year ending June, 1899. We are informed that the manuscript of this report has lain in the hands of the Queen's Printer for months. It is unfortunate that the members of the House of Commons should allow their

pleasure in long speeches and desire to be reported at length before the gaze of admiring constituents to retard the business of the country with which so often their orations have no relation visible to the lay mind. If the Queen's Printer would publish less Hansard and more departmental reports, the country would be better served. It is especially important in this young and growing country that the results of the researches made by the very able staff of the Geological Survey Department should be placed before the public as soon as possible. This is the chief authority on mining matters in Canada, and we look to it for suggestions and information, or would do so, if the reports reached us in reasonable time.

Do the taxpayers ever think that each idle word of the millions poured out at Ottawa costs money to print, money that is needed for the proper conduct of the public business of the country? Let us have less talk from the House of Commons and more frequent reports from the trained specialists employed by the august body. The latter know something which we want to know, and they will say it in as few words as are necessary.

REVERSING A DYNAMO.

"C.", Montreal, asks: "What are the changes, if any, necessary in the connections of (a) a series, (b) a shunt, (c) a compound wound dynamo, in order to keep the polarity of the circuit the same, when the dynamo is running in the reverse direction to its original rotation?" After reversing the brushes, interchange the field magnet connections.

VENTILATION AND HEATING.*

BY W. B. SNOW.

In the combined process of heating and ventilating, a specific amount of heat is in all cases required to compensate for transmission losses to the colder outdoor atmosphere, and a certain other quantity to provide for the warming of all air which intentionally or otherwise enters the room from without. The former amount varies with the character of the construction and the difference between indoor and outdoor temperatures. It is independent of the volume of air supplied for ventilation. The amount of heat required for tempering the air supply for ventilation *alone*, is directly proportional to its volume, and is that necessary to raise it to the temperature of the room. This is in no way available for heating, but it is all important in securing satisfactory ventilation, which when properly provided, grows effective in proportion to the expenditure. The relative costs of heating and ventilation for different rates of air change are well exemplified in Fig. 1 Here, as is proper, the cost of mere heating is shown to remain constant, but the temperature of the admitted air decreases, while the cost of ventilation increases with the volumes admitted. Inasmuch as a cold room will not be tolerated, while a vitiated atmosphere will be endured, we have here the principal reason why so few buildings are well ventilated, namely, the cost of good ventilation

We are not to assume, however, that where no ventilation is intended the fuel expense incurred is only that for warming. In the ordinary dwelling heated by direct means, such as stoves, steam, or hot water radiators, the effect of ventilation resulting from infiltration of air, is to add at least 50 per cent to the mere cost of warming. Where the ventilation is intentional as with a furnace, or with indirect systems, this may readily amount up to 100 per cent and over. Therefore in the consideration of more effective systems of ventilation, it is only proper to consider that portion of their expense of operation which is additional to that of existing, although inadequate systems. Viewed in this light, the cost of securing good ventilation is by no means great, while the improving effect upon the health amply warrants its introduction The cost of ventilation is largely dependent upon the method employed. Natural ventilation either through flues or by leakage is the result of a difference in atmospheric densities and pressures, due to internal and external temperature differences. Consequently the degree of ventilation usually varies with the outdoor temperature, and is lowest when that is highest. Such a method is therefore absolutely unstable.

*A paper read before the Applied Science Society of McGill University session 1899-1900.

The effectiveness of an exit flue can be increased by warming the air within by means of gas flames or steam coils, but evidently all the heat thus imparted represents an absolute loss. This loss can, however, be almost entirely avoided by the employment of mechanical

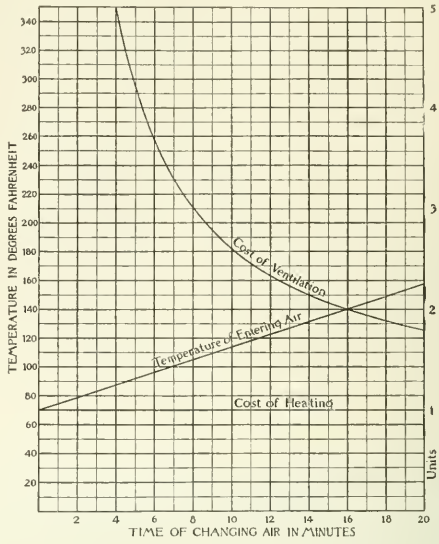


FIG. 1

means for producing the necessary air movement. The most effective device for this purpose is a fan blower. Prof. Carpenter has shown by the accompanying table the ratio of efficiency of mechanical ventilation to that of heat ventilation, air being discharged from the top of the flue into the outside atmosphere of 60 degrees temperature:

TABLE SHOWING NUMBER OF TIMES THAT FAN OR BLOWER IS MORE EFFICIENT THAN A CHIMNEY IN DISCHARGING AIR FROM THE TOP. OUTSIDE TEMP. 60 DEG. F.

Combined Efficiency Fan and Engine Condition	Exhaust Steam Wasted			Exhaust utilized 11.3 Average.
	0.003 Poorest.	0 0066 Average.	0.0125 Best.	
Height of Chimney, Feet	Ratio of Efficiencies.			
10	28	62	120	1060
20	14	31	60	530
30	9.3	20.6	40	353
40	7	15.5	30	262
50	5.6	12.4	24	212
60	4 7	10.3	20	177
70	4	8.6	17	151
80	3.5	7.75	15	133
90	3.1	6.90	13.3	118
100	2.8	6.2	12	106
125	2.2	4 95	9.6	85
150	1.9	4.15	8	71
175	1.6	3 58	6.85	61
200	1 4	3 1	6	53
250	1.12	2 5	4.8	43
300	0 93	2.07	4	35

Three different fan efficiencies are chosen to represent actual practice, and comparison is made both with and without the utilization of the exhaust from the engine When a fan is employed for the purpose of ventilation, the action is positive, and air in any required volume can be handled without reference to the atmospheric conditions. Its use is imperative in buildings where the per capita space is small and the maximum air supply is to be provided. The term "fan" as here used, comprehends only that class of air moving machines in which air enters the inlet in a direction parallel to the fan axis, and is discharged at the circumference in a direction at right angles with the axis here shown The disc or propeller type of wheel, of which there are several varieties, has its place as a ventilating machine, but should be employed only where the resistances are not great It serves best for exhausting purposes, particularly where used in connection with a heating and ventilating system in which the warm air is forced in by a fan of the centrifugal type

A fan wheel of the latter type is almost always enclosed in a steel plate housing with proper inlet and outlet openings. The character of the material makes possible the ready construction of any special form to meet specific conditions. The illustrations serve to present the leading types. The capacity of a centrifugal fan is an exceedingly variable quantity, depending primarily upon the resistance incident to its operation. A properly enclosed fan wheel of the ordinary centrifugal type is always capable of maintaining a specific pressure over what is known as its capacity area of outlet, which area is dependent upon the design and dimensions of the wheel, and is greater for a fan having two inlets than for one acting as an exhauster, and having only one inlet. It is approximately represented by the formula:

$$\frac{DW}{X} \text{ equals capacity area}$$

In which D equals diameter in inches.
W equals width at circumference in inches.
X equals constant.

For an exhauster of the ordinary commercial proportions, namely, with the width of casing approximately one-half the diameter of the wheel, the value of X may be taken as 3. This established capacity area has no relation to the area of the outlet in the casing, which may be of any size, but is usually about twice the capacity area. The velocity of the air discharged through this latter area is practically that of the circumference of the wheel, and the pressure created is that corresponding thereto.

If the area of discharge be increased above that calculated by the above formula, the velocity and pressure will be diminished and the volume increased, but not in direct proportion to the area. The conditions presented by an outlet having the capacity area are substantially equivalent in effect to the maximum resistances imposed in any system through which air movement is maintained by the fan.

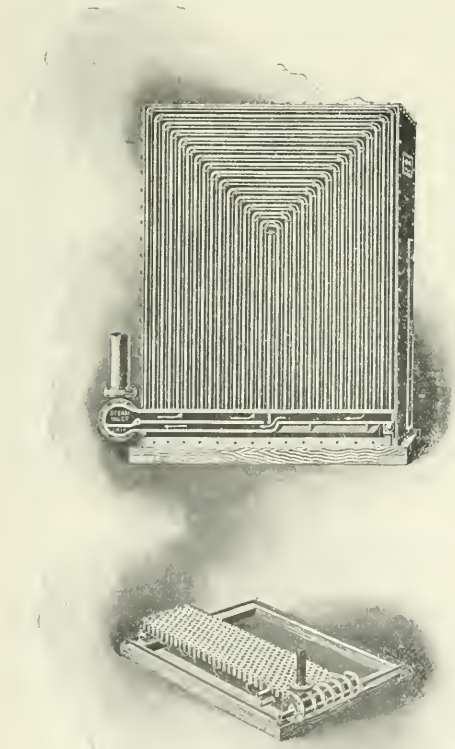


FIG. 2

Ordinarily, and in a heating and ventilating system in particular, these resistances are far less, and the volume of air delivered through a full outlet exceeds by 30 to 50 per cent the maximum amount as above calculated. For other wheel dimensions it may range from 20 to 80 per cent. in excess. The volume discharged increases directly as the number of revolutions, the pressure created as the square, and the power required as the cube of the speed.

It is manifest that air may readily serve as a vehicle of heat for maintaining the desired temperature within an apartment. Evidently the air must be pre-heated, and therefore the plenum of pressure method of supplying is preferable to the vacuum or exhaust method. All local or direct heating surface is eliminated from the rooms, and may be massed in connection with the fan, thereby greatly simplifying the details of installation. The heating surface thus provided almost universally takes the form of a steam coil, built up in sections as shown in Fig. 2. The pipes, usually one inch in size, are here set 2½ inches on centers, thus providing a free area for passage of air equal to

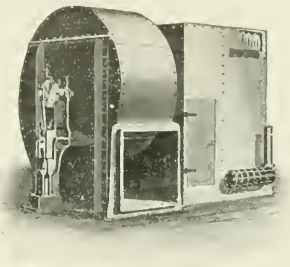


FIG 3

about 40 per cent. of the gross area of the face of the section. The air passing through such a heater must be warmed by contact. The increment due to the radiation is very slight. Therefore the standard arrangement of pipes here shown, which thoroughly breaks up all currents, best serves the purpose by insuring intimate and constantly changing contact

The compactness of this construction is shown by the fact that within the space measured by 6 feet in length, 7 feet in height and 7½ inches in thickness, there may be massed nearly 1,000 lineal feet of one inch pipe. Such construction readily lends itself to manifold arrangements in connection with fans of various types, as is very clearly shown by a few examples. Fig. 3 presents the standard type with full

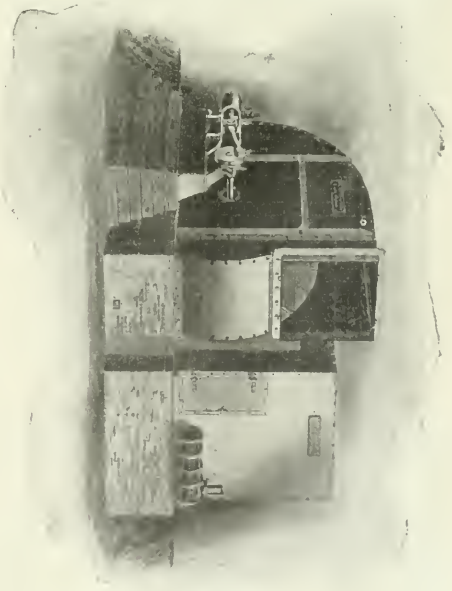


FIG 4

housed form and direct connected upright engine. Fig. 4 indicates the type employed when the fan is large. A portion of the scroll is then formed in the brick foundation. A steel plate jacket in each case encloses the heating surface. The most important feature of this type of combined heating and ventilating apparatus, familiarly known as a hot blast apparatus, lies in the fact that the rapid movement of air

across the heated surfaces renders them vastly more efficient than when exposed in still air. In other words, far less surface is required for the same heat transmission.

The effect of moderate rates of air movement as determined by Prof. Carpenter for ordinary indirect radiators with natural circulation of air, showed that with an air temperature difference of 150 degrees and direct radiation in *still air*, the heat transmission per hour per degree difference is about 1.85 B.T.U per square foot, while with a velocity of 10 feet per second it is increased to about 6 B.T.U. In other words, the heating surface becomes over three times as efficient. In a hot blast apparatus, consisting of a fan and heater like those just illustrated, the heat transmission when the air velocity is 1,200 feet per minute is on the average about 10 B.T.U., or over five times as much as in the case of direct radiation.

The effect of higher velocities and of different steam pressures is well shown in Fig. 5 by two curves indicating the results of tests of Sturtevant heaters in connection with fans. The relative condensation increases with both of these factors, but as indicated by the other curve, the relative temperature increment with a given steam pressure decreases with the velocity. This is the natural result of moving a larger volume of air across the heating surface, and decreasing the time of contact. Disregarding the expansion by heat, the volume is proportional to the velocity, therefore we may determine the relative heat transmission by multiplying the relative velocity by the given condensation.

The rate of condensation is naturally dependent upon the temperature difference between air and steam, and is therefore greatest with the maximum difference. Hence, the less the depth of the heater, the less the total temperature increment of the air, but the more rapid the rate of transmission from steam to air. With increasing depth of heater, or of the number of rows across which the air must be passed, there is a corresponding decrease in the average condensation per

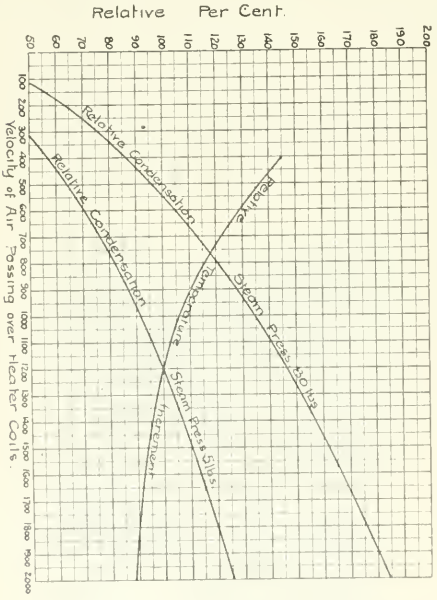


Fig. 5

square foot. The surface first exposed to the air of course continues to maintain the same efficiency, but the surfaces subsequently passed over are progressively exposed to smaller and smaller temperature differences.

The exact conditions in a Sturtevant heater operated in connection with a fan which produces a mean air velocity flow of 1,200 feet per minute through the free area of the heater, are presented in the accompanying curves, Fig. 6. From these and the preceding curves it is evident that the greatest surface efficiency is secured with the highest velocity of air and the least depth of heater. Practically, however, it is necessary to limit the velocity of the air, and to make the heater of sufficient depth to give the required temperature increment to the air. Beyond a certain point the low efficiency of added surface does not warrant its introduction. Furthermore, in the case of a building like a factory, so sparsely occupied that the problem of heating is of primary importance, the greatest economy in this process will be secured when the air volume supplied is the least, and its temperature is the highest. In the ordinary building of this type, the air which is actually required as a vehicle for the heat usually exceeds what is necessary for the purposes of ventilation. As all air supplied to the building must necessarily escape from it at the mean internal temperature, the opportunity for saving is apparent.

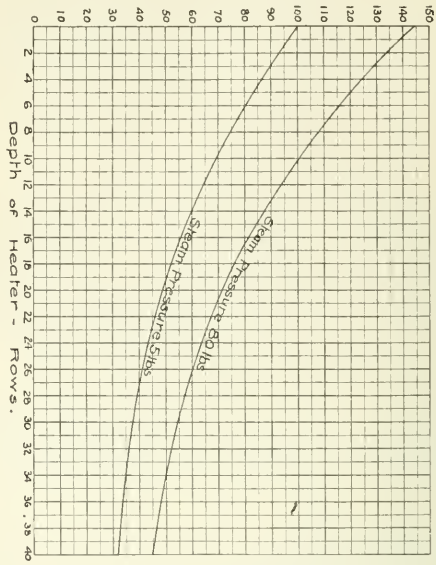


Fig. 6

A fair compromise between extreme conditions consists of an arrangement in such a building whereby the fan is operated at a circumferential speed approaching 5,000 feet per minute. The fan engine exhaust is utilized. The mean air velocity through the heater is about 1,800 feet per minute, and the heater is of sufficient depth to warm the air to about 140 degrees in zero weather.

The design and manner of application of such an apparatus, and the method of air distribution employed in this system, must of necessity depend upon the character of the building, its surroundings and its uses. The ordinary structure devoted to manufacturing purposes presents the simplest of all problems. As a rule the per capita space for the operatives is large, and the heating is to be considered as of paramount importance, while the ventilation, although sufficient with the blower system, is in a sense incidental. In fact ample ventilation may usually be secured by allowing the fan to draw its supply from the building itself, thereby simply turning the air over and over, and merely adding to it the heat necessary to offset the transmission and leakage losses. To this end it is most desirable that the apparatus be placed as near the center of the building as possible, so that the air may be drawn back to it from all sides. Such location also simplifies the distributing system, and reduces the cost.

(To be continued).

IMPROVEMENTS IN PRIVATE DRAINING.

BY W. M. WATSON.

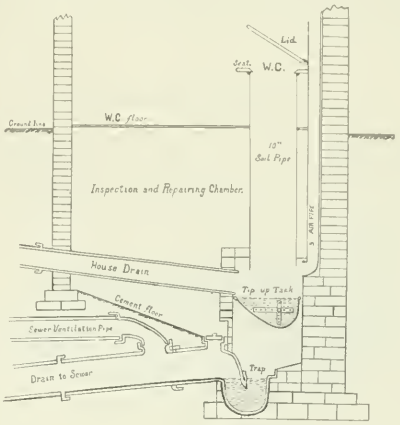
Since 1807 various articles have been published in The Canadian Engineer showing that excesses have lately become fashionable in erecting plumbing fixtures and laying down private drains which have not been to the advantage of the public health to the extent that the promoters try to make the public believe. On the contrary in fact the intricate arrangements and the numerous joints, bends and pipes at present used are more noted as a bill of expense than as of any real value to the public health. We have referred chiefly to the introduction of the interception trap, and many of the so called vent pipes, which prevent a straight circulation of air through the drains and sewers; and the custom of placing a complicated arrangement of bends and pipes between the floors and ceilings, which damages the plaster work and rots the joists. It also prevents the flow of air from above the roof, which should be carried down to the street sewer with the discharged waste water from the fixtures.

We have in previous articles shown that both the public sewers, the private drains, and the plumbing, can be well ventilated and aerated, and at the same time very much simplified in their construction, by installing them on another principle. For it has been clearly demonstrated that if sanitary work is properly designed every discharge of sewage will convey to the main sewer about three times its bulk of atmospheric air, which becomes thoroughly mixed up with the minute particles of the sewage, when it strikes the walls of the said pipe immediately opposite the branch, that the sewage enters on leaving the fixtures, and at once commences what may be termed the first part of the purifying the town sewage. When W. B. Buchan invented the system of placing an interception trap on all private drains, the only forcible argument he used was, "that it would prevent the foul gases from the public sewer passing on through the private drains into the houses." He probably did not know at that time that a well ventilated and self-cleansing sewer could not generate any dangerous gas, and on that ground there would be none to enter the houses. He should have given his attention to improving the aerating and cleansing appliances of the public sewers, but he did a contrary thing, and persuaded the authorities to enforce the placing of an interception trap on the private drain, which totally abolished the only method used at that time of properly ventilating the street sewers, by drawing off the gases, and creating a circulation of fresh air through the air entering the sewer down the grates on the street, then passing downward and on through the sewer, and up the private drains and house soil pipe to above the building roof.

The new system here described will effectually sever the public sewer from the house drain, and there is no chance of gases passing from one to the other, while it still retains the old method in use before the interception trap was thought of, of arranging private drains and plumbing in such a way that each house contributed its fair share of air to the sewers, and the tip up tank here described, and other appliances used to form the flushing and ventilating apparatus may also have an outside water closet attached, as shown in the illustration, to be flushed with waste water from the kitchen sink, and other fixtures (if any), that the building contains, superseding the present expensive kind of outdoor closets, which easily get out of order on account of requiring water pipe and valve, beside being usually wet and dirty, which causes them to smell. Our present outside closets are all served by stool valves, that cannot pass sufficient water in a given time to flush a closet; two gallons of water dropped suddenly down a closet will drive the solids forward to the sewer easier than 100 gallons can do when dribbling from a small stop valve. This is why many of our private drains get choked and totally disorganized, because the closets not getting a reasonable flush, the solids cannot be forced forward by the light stream the stool valve gives, but it will easily be observed by studying the illustration that the design of closet here presented will not only give a good force that will drive the solids at once to the street sewer, but on account of the bulk of sewage that is suddenly tipped into the drain, it must also give the drain a good scouring each time the tip-up tank discharges its contents.

There are still a great many open privy pits used that contaminate the atmosphere and injure the health of those that are compelled to inhale the odors from them; these abominations ought to be removed, and no doubt many of them would have been already abolished, if some simple, durable and inexpensive alternative had been offered before. Many of the dwellings using them cannot afford sanitary arrangements inside, or the present sample of a water closet outside, with its $60 cost of erection and an annual charge for water rent and repairs, but perhaps the one we here describe will meet the want, and help all those owners of cheaply rented property to do away with the foul pests.

The method adopted by some towns of carrying each house drain along the front, across the lawns and streets, is a very unwise and unsanitary one, and where this custom is adopted it may make it rather unhandy to adopt this flushing and water closet combination. Many towns have the wisdom to run their local branch drains along the back lanes or near the rear of the buildings wherever practicable, because the sanitary appliances of most dwellings are at the rear, therefore they are easier and quicker connected to the outside drain pipes; then the front streets, sidewalks and grass are not damaged by settling or ripping up for repairs, costing a large sum annually. The illustration shows the street sewer terminals erected with a P trap at the bottom of the brick vault. Near the knee of the trap



is a full sized ventilation pipe, which must be carried up the outside wall of the main building, to above the roof. This will convey the sewer gases from the street and private drain to above the building. In the vault is placed a tip-up tank, which may be made to hold any quantity of water, but for a private house about five gallons would be sufficient. When this is run full of sewage, it will suddenly turn a quarter way round, and discharge its contents into the drain, then fall back to its former level position to be refilled. The trunk drain from the premises conveying all the sewage, roof and yard water, discharged delivers its contents into the tip-up tank which measures the fluid and forces it into the sewer trap at full bore. If the house waste and soil pipes are properly arranged, the head of each line of pipe will terminate with an open end, outside, above the roof, and usually they convey the air from the street drains, or if the new system of placing an interception trap on the house drain is adopted, then they draw air from the fresh air pipe that adorns the front of so many homes, but in this design they will draw the air from the vault and tip-up tank, and they in turn will be supplied with fresh air by the air passing down the large conveying tube (when the water closet seat lid is open) and when the lid is closed, they will be supplied by the 3-inch local vent pipe placed on the opposite side, and over the tip-up tank, and which is shown to pass through one corner of the water closet, and extend out to above the roof of the main building.

The water closet is formed by extending a sheet metal or vitrified pipe from the plate that covers the vault to the underside of the closet seat. The droppings are expected to fall into the sewage water contained in the tip-up tank without touching the pipe, and on that account cleanliness is secured. The closet is supposed to measure 5 feet by 3 feet, and half the floor lifts to form a door to enter the inspection and repairing chamber, and every part is arranged so that chokes can be quickly and easily removed without disarrangement of any pipes, traps or fittings.

Owners of premises who can afford inside closets and do not need any such arrangement outside, may sometimes use the tip-up tank to flush and keep their private drains clean, especially where they have a long length of poorly graded pipe, and in streets where the drains are small, and inhabited houses few; and on that account there cannot, at any time of the day, be more than a dribbling stream passing through the street sewer pipes, the sewage might be collected at some convenient point with a large tip-up tank, and cause the sewer pipe to be flushed, cleaned and aerated a few times each day with its own waste water, without going to the expense of having fresh water flushing apparatus placed at the head of each line of sewers. There is nothing so unhealthy, or that is so easily choked and silted up, as a sluggish sewer.

I might here add that in February, 1899, when the illustration showing how plumbing fixtures might be connected above the floors was published, there appeared to be no closet basin

made that could be easily connected in that way, but we sent copies of the article to manufacturers, and now there is a basin on the market that is the very article required (as shown in the illustration), because it is a P trap with a brass bend attached, which is coupled to the closet with a union joint enabling the end of the bend to point in any direction towards the soil pipe branch in whatever position the vertical soil pipe might be placed.

PETROLEUM IN GASPE, QUE.

The following statements are extracted from the annual report of J. Obalski, M.E., Inspector of Mines for the Province of Quebec, which has just been issued. A great deal of interest has been taken in these deposits, but hitherto very little definite information could be obtained.

He states that he visited the Gaspe basin region in October last, and is in a position to supply the following information on the works which are being prosecuted there for petroleum, the results obtained warranting the laying down of a line of pipes and the erection of a refinery.

The Petroleum Oil Trust, which controls this region, has organized at different periods the following branch companies: 1. "La Societe Belge des Petroles du Canada," formed about 1896, bored some wells without much result. 2. The Irish Proprietary Co., since called the "Gaspe Oil Field Co.," formed in January, 1898, bored three wells on block 40 to the depths respectively of 1,055, 2,815 and 1,925 feet, the last with some success. The same company is preparing the foundations and the timber for three new wells, which will be bored in the same district and in the neighborhood of the paying wells of the Canada Co. and of the P. O. T. Their present wells are pumped and the Canada Co. is to take their output and convey it to the refinery. 3. The Canada Petroleum Co. (Ltd.,) London & Manchester, capital £300,000, began operations in June 1899 and worked nine wells, six of them being in the district of No. 27 (block 40), and three in that of No. 5 (Gaspe Bay South), one on lot 1-35 and two on 1-30. These wells are numbered from 1 upward and form a series special to this new company.

At present, the company is pumping three wells, Nos. 1, 2 and 5, and appears to be satisfied with the results obtained. Nos. 3, 4 and 6, regarded as not so good and the company having little plant have been plugged after removing the pipes; No. 8, on lot 1-35, has been abandoned and Nos. 7 and 9 are being bored on lot 1-30, depths of 700 to 900 feet having been now reached. The same company has laid down a line of 2-inch pipes, 11 miles in length, which extends from the district of No. 27 to the point where the refinery is to be built on the southern part of lots 1-31 and 32 of Gaspe Bay South near the York river. The greater part of the machinery and plant for that structure has arrived and it is hoped to have them in operation during the summer. The total capacity of the reservoirs will be 25,000 barrels, and 250 barrels a day can be refined; but this quantity will naturally be less at the start. An iron tank of 2,500 barrels capacity has already been erected on lot 1-31 near the refinery, to receive the oil from the district of No. 27, and another of 500 barrels has been put up near this same well. There is already at the different wells, in wooden tanks or in barrels, a certain quantity of petroleum, which will be sent to the reservoirs as soon as the pipe line is opened.

The Canada Petroleum Co., as well as the other two, is working on the P. O. T.'s territory, pursuant to certain special arrangements according to which the P. O. T. binds itself to cede to them 10 acres of land around each well sunk, and in addition, 100 acres for the site of the tanks. All these companies are actually under the same local management as the P. O. T., which supplies them with the necessary plant for building and boring. When the refinery and tanks are completed, the other producing wells will be connected with the main pipe line. None of the Canada Petroleum Co.'s wells have yet been torpedoed, but they will be so later. The P. O. T. will pump the producing well and proposes to sink others during the summer, and to continue to explore and open up new districts. In the district No. 27, oil has been struck in paying quantities, generally in the schists, about 1,500 feet down before reaching the limestone which is found at a depth of 2,000 to 2,400 feet.

When I visited this district in October last, says Mr. Obalski, No. 1 was down 1,550 feet. It was being pumped and was yielding, I am told, two to three barrels per day. No. 2 was down to 1,570 feet, with 1,400 feet of oil in the well; the oil spouted a little at the start, but since then it has been pumped with a result which compares with that of No. 1. No. 3 in the district of No. 5 (P. O. T.) was 1,275 feet down and has since been abandoned as well as another in the neighborhood where a derrick had been put up, but it was not sunk owing to the failure of No. 3. No. 4 was 750 feet down, the derrick of No. 5 was being erected and preparations were being made for No. 6. No. 8 in the same district and 7 and 9 in Gaspe Bay South, have been since sunk. The tank of No. 1 well was full of oil, as well as one at No. 27, and in well No. 2 there was a column of oil rising to near the surface, which has since yielded—I am told—80 barrels. In addition, there were a certain number of barrels full at the other wells. The pipe line was half completed, and the plant was coming in for the refinery, the site for which had not yet been determined. I saw several wooden tanks which are said to have been filled with oil, but from which it leaked away through the joints or the knots of the wood. The P. O. T. had not started any other wells since No. 33, those begun last year, 28, 29, 33 having been continued with variable success; the company has equipped Nos. 19, 20 and 27, for pumping later on. It has also erected a saw mill to supply the derricks and other constructions.

There is therefore reason to hope that this year we shall see refined oil shipped from this region. Samples from district No. 27 have been sent to the Paris Exhibition. I append a few analyses, of which I was given communication showing the quality of the product:

Light Green Oil very Volatile from District No. 27

Density, 0.828 at 60°F	
Lighting Point (Abel test) 0°F	
Light essences (gasoline, benzine)	16%
Kerosene, d. 0.804, lighting point, 73°F.	41%
Intermediate products and heavy oils with solid hydrocarburets	40%
Losses	1.00%
Coke obtained by dry distillation	1.36%

Amber Oil from District No. 5.

Density, 0.795 à 60°F	
Lighting point (Abel), 20°F	
Light essences (gasoline, benzine)	21%
Kerosene, density 0.780	35%
Lubricating oils and paraffine	42%
Losses	1.00%
Coke	0.75%

These results were obtained by cooling at 20°F., but by employing the usual process of distillation, 79% are obtained of a product with a density of 0.799, and a lighting point at 73° F., from which the paraffine can be afterwards separated by cooling.

The P. O. T. has obtained from the Quebec Legislature a charter authorizing it to lay down lines of pipes and granting it certain powers relative to the refining of petroleum.

TORONTO HARBOR.

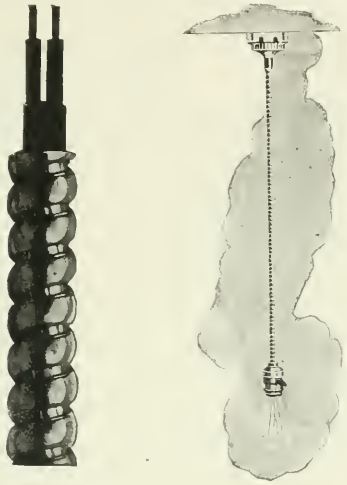
The Dominion engineer, J. Rouer Roy, recently arrived in Toronto to make an examination of the harbor in conjunction with the engineer appointed by the city to consult with him, W. T. Jennings, C.E. Mr. Jennings' wide experience in this particular department of engineering, and his standing in the profession make his advice invaluable to the city and the government. The inspection of the harbor was made by the two engineers in the company of Kivas Tully, one of the oldest and most experienced engineers in Toronto; E. B. Temple, local government engineer; C. W. Postlethwaite, harbor master; P. Sempson, shipping master; Prof. Galbraith, of the School of Practical Science; Clarkson Jones, C. H. Rust, the city engineer, and others. The examination made showed that a great quantity of soil was carried down into the harbor from the river Don. This was estimated to amount to 17,174 cubic yards per annum. The eastern entrance to the harbor is constantly silted up and dredging is always necessary. The intention of the Dominion Government is to extend the eastern wall of the gap 1,000 feet into the lake, and the western wall 1,800 feet, which will make them of equal projection, and equalize as much

as possible the influence of the currents now making the beach on both sides of the gap.

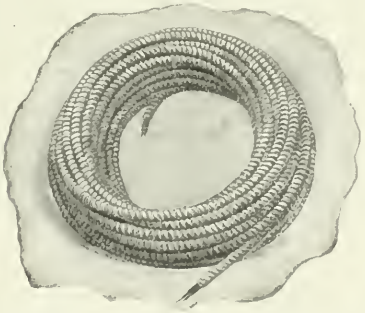
The whole problem of harbor improvement with its accompanying questions of trunk sewers and sewage disposal must shortly come up for settlement.

ARMORED CABLE.

Since the introduction of the conduit system, improvements in electrical appliances and methods of construction have followed each other rapidly. The Sprague Electric Company, which owns the patents and equipments of the Interior Conduit & Insulation Company, announces the successful appearance upon the market of the Greenfield flexible steel armored cable. For some time certain engineers have questioned the advantages of a "drawing in" system of interior wiring, involving as it does, two expensive operations, one being necessary for the installation of the conduit, another for that of the conductors,



and base their argument on the claim that considerably less than one-tenth of one per cent. of the electric conductors in buildings are subject to disturbance or removal. Why must two installations be imposed on the user of electric current, when only one should be necessary? Two replies have invariably been ready for this question. First, the absence of definite knowledge regarding the life of insulation. Second, the entire absence of any suitable flexible armor or covering that would protect insulation from mechanical injury. The doubt ex-



pressed in the first argument has been removed by time, there being innumerable installations made from ten to fifteen years ago, and in which the wires show a higher insulation resistance to-day, than was obtainable immediately after they were placed in position. The Sprague Electric Company claims that it replies to the second argument by placing upon the market the Greenfield flexible steel armored cable, comprising electric conductors so insulated and braided as to be thoroughly protected from atmospheric influences and armored so as to defy any mechanical injury incidental to installations in the fireproof or other buildings of the present day.

Engineers will recognize the advantages of flexible conductors so thoroughly insulated and armored for use in marine or ship wiring where a rigid conduit system can only be installed at great cost in order to overcome the many obstacles presented by reason of the form of a vessel's structure, the small space available for equipments and fittings, excessively high temperatures and incessant vibration of the ship.

Factory and mill wiring has been accomplished chiefly by the use of insulating knobs and cleats, molding being used in some cases for the larger conductors. Where insulators and cleats are used, as in the majority of such work, the wires,

being run from beam to beam, become dust collectors of the best kind, and especially is this the case in cotton and flour mills where the conductors will support an accumulation of lint and fine dust many times exceeding their own size. Perhaps the most costly feature of "open wiring" in such places is the general destruction caused by the breaking or slipping of a belt, which, when once caught fast in the wiring usually brings down several sections, sometimes wrecking or disabling valuable machinery by the operation. These objectionable possibilities are said to be entirely eliminated by the use of the Greenfield flexible steel armored cables and cords, which can be firmly secured on the surfaces of the structure wired.

Finished buildings frequently present to the engineer and contractor wiring problems he would prefer to avoid, the alternative being in many cases, the practical ruin of costly decorations, or the fishing of conductors without conduit from outlet to outlet, leaving their insulation at the risk of tools or rats.

New buildings equipped with electrical conductors in accordance with the practice of the present day require, as before stated, not less than two distinct installations—one of conduit, another of conductors. The electrical contractor is compelled to make progress of his work conform to that of other workmen, and is often subjected to costly delays. Alterations from original plans, however necessary or desirable, are in most cases costly in the extreme. Under the most favorable conditions, the Sprague Electric Co. states that the electric wiring equipment is suggestive of a certain feeling of doubt amounting almost to distrust, and lacks that element of permanence and stability with which it should be associated, and to which it is justly entitled. These flexible products have been approved by the Underwriters' National Electric Association of the United States.

THE NOSE OF THE WOLF.

A rather curious though not altogether novel attempt to secure a portion of the public domain for private use is found in Bill No. 37 now before the Dominion Parliament. This bill, very generally believed to be in the interests of the Standard Oil Company, is a renewal and amendment of an act of 1887 and seeks to give the corporators under the innocent guise of an "oil pipe line" the power not only to pipe oil, but "to pipe the products and by-products of coal or any combination of coal and oil and their products and by-products;" in other words, the power to manufacture and distribute coal gas or water gas or either or both, and to enter any municipality, lay its pipes and conduct its business without leave or license and at their own sweet will. Clause 2 gives the company power to lay pipes "for the purpose of delivery and distribution (of oil) to the consumers thereof, as to the company seems fit, (and) for the purpose of carrying through the said pipes the crude oil, distillate or refined oils, or by-products of petroleum, their products and by-products, together with the products and by-products of coal, or any combination of coal and oil, their products and by-products, from the places of production to the works and delivering stations of the company, and from the works and delivering stations of the company to all places where the company may wish to deliver or distribute the same to the consumers thereof." No reservation is made of municipal rights. Also, under the shadow of this convenient "pipe line" the incorporators seek powers under two sub-sections (d. and e. section 2), to enter into the mining, refining and manufacturing of metals of every description, etc.

L. J. MARIEN, C. E.

L. J. Marien, who is associate member of the Canadian Society of Civil Engineers, was appointed superintendent of Montreal waterworks 21st May, 1900. He was born in Montreal in July, 1858, and was educated at the Catholic Commercial Academy of Montreal, 1866-69; at the Montreal College for classical studies, 1870-1877; at the Polytechnic School of Montreal, from 1877-1880, for scientific course, obtaining the diploma of civil engineer; from 1880 to 1882 he was assistant to J. A. U. Beaudry, C.E. and P.L.S., Montreal; 1882-1892, assistant to Joseph Rielle, C.E. and P.L.S., Montreal. From 1892 to date of the present appointment, M. Marien has been assistant engineer of the Road Department of Montreal under the direction of Percival W. St. George, C.E., the city surveyor.

THE PRACTICAL MAN.

WROUGHT-IRON CHAIN CABLES.

The strength of a chain link is less than twice that of a straight bar of a sectional area equal to that of one side of the link. A weld exists at one end and a bend at the other, each requiring at least one heat, which produces a decrease in the strength. The report of the committee of the U.S. Testing Board, on tests of wrought-iron and chain cables contains the following conclusions:

"That beyond doubt, when made of American bar iron, with cast-iron studs, the studded link is inferior in strength to the unstudded one.

"That when proper care is exercised in the selection of material, a variation of 5 to 17 per cent. of the strongest may be expected in the resistance of cables. Without this care the variation may rise to 25 per cent.

"That with proper material and construction the ultimate resistance of the chain may be expected to vary from 155 to 170 per cent. of that of the bar used in making the links, and show an average of about 163 per cent.

"That the proof test of a chain cable should be about 50 per cent. of the ultimate resistance of the weakest link."

From a great number of tests of bars and unfinished cables, the committee considered that the average ultimate resistance, and proof tests of chain cables made of the bars, whose diameters are given, should be such as are shown in the accompanying table:

ULTIMATE RESISTANCE AND PROOF TESTS OF CHAIN CABLES.

Diam. of Bar.	Average Resist. = 163 per cent. of Bar.	Proof Test.	Diam. of Bar.	Average Resist. = 163 per cent. of Bar.	Proof Test.
Ins.	Lbs.	Lbs.	Ins.	Lbs.	Lbs.
1.	71,172	33,840	1.9/16	102,283	77,159
.1/16	79,544	37,820	.5/8	174,475	82,956
.1/8	88,445	42,053	11/16	187,075	88,047
.3/16	97,731	46,468	.3/4	200,074	95,128
.1/4	107,440	51,084	.13/16	213,475	101,499
.5/16	117,577	55,903	.7/8	227,271	108,058
.3/8	128,129	60,920	.15/16	241,463	114,806
.7/16	139,103	66,138	2.	256,040	121,737
.1/2	150,485	71,550			

WEIGHT OF CAST-IRON PIPE PER FOOT IN POUNDS.

These weights are for plain pipe. For hautboy pipe add 8 inches in length for each joint when using this table. For copper add 1-5; for lead, 3-5; for welded iron add 1-15, or multiply by 1.0667.

Diam'ter of Bore in Inches	Thickness of Pipe in Inches.									
	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
1	3.07	5.07	7.38							
1 1/4	3.69	6.00	8.61							
1 1/2	4.30	6.92	9.84							
1 3/4	4.92	7.84	11.1							
2	5.53	8.76	12.3	16.2						
2 1/4	6.15	9.69	13.5	17.7						
2 1/2	6.76	10.6	14.8	19.2	24.0					
2 3/4	7.37	11.5	16.0	20.8	25.9					
3	7.98	12.5	17.2	22.3	27.7	33.4				
3 1/2	9.21	14.3	19.7	25.4	31.4	37.7				
4	10.3	16.1	22.2	28.5	35.1	42.0				
4 1/2	11.7	18.0	24.6	31.5	38.8	46.3				
5	12.9	19.8	27.1	34.6	42.5	50.6				
5 1/2	14.2	21.7	29.5	37.7	46.1	54.9				
6	15.4	23.2	32.0	40.8	49.8	59.2	68.9			
6 1/2	16.6	25.4	34.5	43.8	53.5	63.5	73.8	84.4		
7	17.8	27.2	36.9	46.9	57.2	67.8	78.7	89.4		
7 1/2	19.1	29.1	39.4	50.0	60.9	72.1	83.7	95.5	108.0	
8	20.3	30.9	41.8	53.1	64.6	76.4	88.6	101.0	114.0	127.0
8 1/2	21.5	32.8	44.3	56.1	68.3	80.7	93.5	107.0	120.0	134.0
9	22.8	34.6	46.8	59.2	72.0	85.1	98.4	112.0	126.0	140.0
9 1/2	24.0	36.4	49.2	62.3	75.7	89.3	103.0	118.0	132.0	147.0
10	25.1	38.3	51.7	65.3	79.4	93.6	108.0	123.0	138.0	164.0
11	27.6	42.0	56.6	71.5	86.7	102.0	118.0	134.0	151.0	168.0
12	30.0	45.7	61.5	77.7	94.1	111.0	128.0	145.0	163.0	181.0
13	32.5	49.4	66.4	83.8	102.0	120.0	138.0	156.0	175.0	195.0
14	35.0	53.1	71.4	89.4	109.0	128.0	148.0	168.0	188.0	208.0
15	37.4	56.7	76.3	96.1	116.0	137.0	158.0	179.0	200.0	222.0
16	39.1	60.4	81.2	102.0	124.0	145.0	167.0	190.0	212.0	235.0
17	42.3	64.1	86.1	108.0	131.0	154.0	177.0	201.0	225.0	249.0
18	44.8	67.8	91.0	115.0	139.0	163.0	187.0	212.0	237.0	262.0
19	47.3	71.5	96.0	121.0	146.0	171.0	197.0	223.0	249.0	276.0
20	49.7	75.2	101.0	127.0	153.0	180.0	207.0	234.0	261.0	289.0
22	54.6	82.6	111.0	130.0	168.0	196.0	227.0	256.0	286.0	316.0
24	50.6	89.9	121.0	152.0	183.0	214.0	246.0	278.0	311.0	343.0
26	64.5	97.3	131.0	164.0	198.0	231.0	266.0	300.0	335.0	370.0
28	69.4	105.0	140.0	176.0	212.0	249.0	286.0	323.0	360.0	397.0
30	74.2	112.0	150.0	188.0	227.0	266.0	305.0	345.0	384.0	424.0

THE WIRE NAIL INDUSTRY.

The phenomenal growth of the wire nail business during the past twenty years in the United States and Canada, is something remarkable. Twenty five years ago, wire nails were hardly known on the American continent. The present annual output in Canada is nearly four hundred thousand kegs, and in the United States six million kegs are manufactured every year. As far as known Pillow & Hersey, of Montreal, built the first wire nail machine in America, some twenty-five years ago. A. Field

& Sons, of Taunton, Mass., followed Pillow & Hersey, by building six machines. From that time to the present the business has advanced with rapid strides to its present gigantic proportions. For many years the cut nail and the wire nail manufacturers sought for supremacy, but in the end the wire nail superseded the cut nail to a great extent owing to the cheaper production of raw material as well as by greatly improved wire nail machinery. Only a few years ago machines that made 500 lbs. of $2^1/_2$ inch nails in ten hours were considered good enough. To-day there are machines in the Pillow & Hersey Manufacturing Co.'s works, Montreal, making nearly 2,000 lbs., of the same size in the same length of time. G. P. Clapp, the superintendent of the works, is the inventor of these machines, and says they will revolutionize the wire nail business. They make two 3-inch nails at each revolution, and run 250 turns per minute, making 3,000 lbs. of perfect nails in ten hours. One operator and two helpers can run ten of these machines, and turn out from 400 to 600 kegs of nails in 22 hours, according to size of nail.

THE ENGINEER, THE MASTER SPIRIT OF THE AGE.

BY C. BAILLAIRGE, C.E., F.R.S.C., ETC.

A recent visit to Boston by the Canadian Society of Civil Engineers, on invitation of the sister society of that city, has strengthened me in the conviction I was arriving at of the truth of the motto which heads this article. In olden times men in power, kings, emperors, presidents, premiers, mayors and other heads or chieftains had the prestige of importance, omniscience. The statesman has hitherto been looked to as an embodiment of a nation's wisdom. In those days he was superior to the architect, the engineer; because, mighty as were the achievements of the latter, they were not those of the mind so much as of brute force and manual labor; as when Cheops, with 20,000 men in 20 years put together the giant pyramid of that name, which was to enclose his tomb, and thus render it indestructible, especially under the mild and unobtrusive climate of Egypt. Obelisks, 100 feet in height or more—10 feet square at base and tapering to 5 or 7 feet at the apex (six to seven thousand cubic feet—say 600 tons), were cut and quarried bodily from the solid rock, moved away on temporary rails and rollers, or as of our days, on spherical balls or shells of steel or iron, confined between upright and inclined timbers scooped or hollowed out to receive them, and armed with metallic bars or lining to reduce friction to a minimum.

Such monolithic mementos of the dead have been loaded on to vessels or pontoons, rafts or barges, transported miles away to foreign climes, and there stood up on end to the utter amazement of our people of the present day. Not, however, as I believe, in the way the Romans are represented to have done the work, by erecting heavy staging to the full height of the monument to be up-ended by handling it from the apex as we hang a stone to place it on a wall or pier; but more probably a structure of false work of only half the height or less, may be hardly more than one-third the height, to swing the monolith from its centre of gravity, and thus stand it on its pedestal; or again, by building for it an inclined plane of solid cribwork or consolidated earth or clay to an equal height of between one-half and one-third the length of stone, and depending on its less or greater taper from base to summit.

Now by moving the stone up this incline of say 500 to 600 feet in length, or slope of one in ten—the base or big end foremost—when the centre of gravity of the obelisk had reached the summit of the incline, its upper edge or toe, the stone would tilt or topple over or around this edge, as if around a hinge joint, till its base reached and rested on the plinth or stylobate or pedestal or dado destined to bear its weight; staging at the same time being used with stays, and struts, and guys, and jack screws to gradually lower it into position and secure its true perpendicularity.

Not that we know, however, how this was actually done, as the ancients in their pride would immediately remove all such false work from around their finished structures; and they seem to have purposely kept no record of it to hand down to posterity, lest one should find them out in their methods of success, thus rendered secret to future generations and to be guessed at, reinvented or reconceived. And so must it have been done at Karnac, where to this day can be seen stones not less than 10 feet square and 80 feet in length lifted bodily to the tops of columns 60 feet in height; the incline in this case having of course to be of the full height of the column to allow of sliding the mass or rolling it into position, (8,000 cubic feet of granite, 700 tons, or thereabout) as no piece of machinery existed then, nor does any crane exist to this day capable of taking hold of and moving such a weight, let alone lifting it from the ground to any higher level; while the effect of the incline would be to reduce the weight, minus a proper allowance for friction, in the ratio of length to height of incline; say ten to one, or 700 tons reduced to 70 and thus made manageable.

But even in more modern times stones have been moved and transported to great distances, which were as giants to those very giants of antiquity, as when, now more than a century ago, a stone for the pedestal of the monument of Peter the Great of Russia was handled with facility though many times the cubical contents and weight of the Egyptian and other monoliths. Again we have the colossal statues of antiquity, over 60 feet in height; the sphynx, etc., and whole temples bodily excavated from or out of the solid rock; but startling rather as the triumph, not so much of mind as of physical and mechanical force over matter, the joint labors of thousands upon thousands of hands for scores of years continued. But all such works were so to say, open secrets, which when once witnessed, any other man could do the same; and the statesman could still hold his own by his additional acquisitions in the literary and scientific, his oratorical, administrative and other faculties.

Since those days more science has been brought to bear by architects and engineers, as in the designing and building of the concrete and cut stone domes and cupolas of the Roman Pantheon, the cathedrals of St. Peter and St. Paul; as well as the noble gothic structures of the middle ages with their vaulted ceilings, their minarets and flying buttresses, where more of mind prevailed and less of mere physical endurance. But, now some 60 years ago, an immense stride was taken by the engineers. Watt had conceived the steam engine and Stevenson the locomotive. Railways were built and tunnelled through mountain ranges, and under the beds of rivers, and here did the engineer begin to tower in earnest above all other men, who had but to look around them to take in the situation and surroundings, and were not concerned with wind stresses, atmospheric pressures, land thrusts, river diversions and the like: the general for instance in the disposition of his forces to meet, beat and dislodge the enemy; while the engineer has to see above him, and beneath him; the keen eye of the architect, as to how his complicated groins will sit upon his arches and his pillars without thrusting them asunder; the engineer, as to how to bring his tunnels and his subways into alignment to crop out where required at the surface or to daylight, and so as not to jeopardize the safety of overlying structures and in no way interfere with existing lines of sewers, gas, water and other piping, electric and other conduits, involving as they do the intricate problem of diversion to right or left or of direct or inverted syphoning, without decreasing their efficiency.

I have said that no piece of machinery existed in antiquity for the raising of such heavy weights as a thousand tons or more; nor even to within half a century of the present time; but since that epoch, the hydraulic ram has been perfected. By its means, stresses can be brought to bear of hundreds of tons upon a single inch, and greater, far greater weights than those of yore can now be handled with perfect ease and readiness.

It is but 40 years ago since Stevenson built his bridge over the Menai Straits, and as the Admiralty would not allow of having the river barred or in any way obstructed during construction, he had to build his tubes on scows or caissons ashore, launch and float them down to destination and then raise them bodily to a hundred feet or more in height. Now each of these gigantic tubes of heavy riveted steel and iron plates with ribs, flanges, and bottoms and tops of cellular construction to add to and secure rigidity of structure, was not less than 464 feet in length, 27 to 30 feet high and of corresponding width.

What then are the obelisks, what the Karnac stones of 5 to 7 hundred tons beside these structures of nearly ten times the weight? These tubes weighed 4,500 tons, or were as heavy, each of them, as one of Her Majesty's 120-gun frigates of that period, with all its crew and armament on board. But the science of the engineer was equal to the occasion: he took hold of them, having first built his supporting towers, and sus-

pended them from the summit thereof by chains of steel in multiple links with pin or articulated joints.

The tubes were raised into position, not by the spending of fabulous sums of money for the erection of inclined planes, or false work, costing more than the very structures they were to be instrumental in erecting; but by the use of two tiny pumps of only 11 inches in diameter with sides and top and bottom also of like thickness to withstand the pressure. A quarter inch jet of water did the work, spreading and swelling beneath the ram or piston under the successive strokes of a 40-h.p. steam engine. The pressure beneath the piston of the ram raised it 6 inches, and with it the end of the tube suspended from its summit, and thus were these tubes raised 6 inches at a time, and alternately at opposite ends, and they were built under as they were lifted to position, and iron beams then thrust under their extremities, and resting on the masonry at opposite sides of the containing grooves; the suspending chains being shortened by a link at a time as the tube reached each successive seven feet towards its final altitude.

Since then there have been greater strides of the mental over the manual features of engineering. Eads built his 500 feet span bridge over the Mississippi, and Roebling his 1,600 feet span aerial over the East river between New York and Brooklyn.

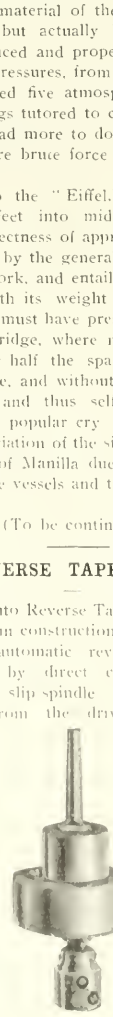
And here it is that pure science has been the directing element in laying foundations in as much as 80 ft. depth of water, where both hydraulic and atmospheric pressure had to be taken in as factors to the solution of the problem, where piers were built afloat on the upturned bottom of a caisson from which the excavated material of the river bed had to be, not raised and lifted out, but actually blown out through 4-inch tubes by men, introduced and propelled through tubes and air locks under varying pressures, from the natural atmospheric to the artificially produced five atmospheres or more within the caisson, and their lungs tutored to conform thereto. And thus again as said, mind had more to do with the solution of the problem than the mere brute force displayed in the structures of the ancients.

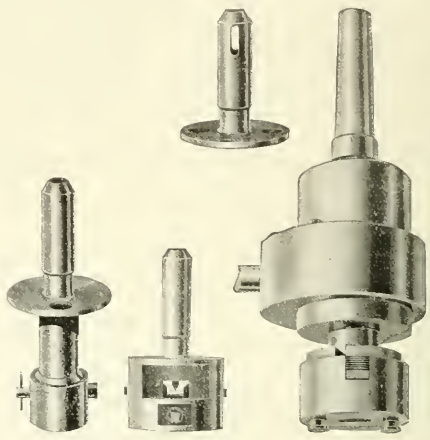
Now come we to the "Eiffel," towering to a height of nearly a thousand feet into mid-air, and this supplies an example of the incorrectness of appreciation of the engineering difficulties of the case by the general public. True the Eiffel is a splendid piece of work, and entailed, of course, much mental activity in dealing with its weight and stresses; but not the mental anxiety which must have presided at the construction of the Firth of Forth bridge, where nearly as great a length of structure (850 feet, or half the span), had to be thrown out horizontally into space, and without scaffolding or false work, instead of vertically, and thus self-supporting. And so with Dewey, for while the popular cry makes a demi-god of him, his own honest appreciation of the situation is that not solely to him was the success of Manilla due, but more so to the engineering features of the vessels and their armaments confided to his charge.

(To be continued).

AUTO REVERSE TAPPING CHUCKS.

The Errington Auto Reverse Tapping Chuck herewith illustrated is very simple in construction, being merely a slip chuck provided with an automatic reverse (just like the drill chuck). It drives by direct connection with the drill press spindle, the slip spindle of the device (carrying the tap), sliding from the driving into the reversing clutches, the gears being used only to back the tap out, and in this device it requires but four steel spur gears to reverse the tap. A marked feature of this device is its wide adaptability, the manufacturer providing a great variety of tool-holders that adapt it for any particular class of work. Only one hand is required to operate the Errington, leaving the other hand free to handle duplicate parts in bulk, by passing them through an undercut slot, or other suitable fixture clamped on drill press table that avoids holding each piece separately. By this method it has tapped from 22 to 33 holes per minute in light work.





Interchangeable tool-holders can also be furnished, as illustrated, this form being particularly recommended for all work that is too heavy to centre itself to the tap, requires to be clamped down to the table, or is otherwise difficult to handle and centre, as the hole can be drilled, tapped, faced, stud set in, etc., all while in line and without stopping or reversing the machine spindle or moving the work. Any make of tap can be used with this device.

This device is very generally used in the United States, where it is manufactured by its inventor, F. A. Errington, 39 and 41 Cortlandt street, New York, N.Y., who makes a specialty of cutting internal and external screw-threads without stopping or reversing the machine, including a complete line of automatically opening dies and collapsible taps.

THE ORILLIA POWER PLANT.

The electric plant at Severn Bridge, which was undertaken some time ago by Orillia, Ont., is still unfinished, though the contractors, the Electrical Maintenance and Construction Co., Ltd., P. H. Patriarche, manager, should have completed the work December 1st, 1899. The Orillia Packet of June 14th makes the following statement of the present position of the work: The contractor has so far received certificates from the town engineer for $43,601.50 worth of work and machinery out of the contract price of $71,000. On this the council has paid $23,438.75, leaving $20,162.75 of the contractor's money in their hands, which under the terms of the contract they can make use of to complete the work. Of this $10,900.37 is the 25 per cent. held back from certificates, and $9,262.38 is on account of the $10,000 which Mr. Patriarche was to deposit as a guarantee. Adding together the $27,398.50 of the contract price for which certificates have not yet been issued, and the $20,162.75 held back, the council has $47,561.25 to complete the contract and satisfy claims against the contractor. The town also gets the benefit of any work done since the last certificate was granted, which was in February. About $12,000 worth of the electrical machinery is still undelivered by the Royal Electrical Company, and a considerable part of the hydraulic machinery is lying at Severn Bridge, and is therefore not yet in the possession of the town. The Royal Company has given notice that it will hold the council responsible for finishing the contract in as econom-

ical a manner as possible, should it be taken over. In addition to the $23,000 odd paid on the contract, the council has spent about $5,000 for supervision, surveys, material for extending the plant in town, etc., the total amount paid out to date being $28,161.72. It is evident that, in any case, more money will be needed to carry the scheme to completion.

Some of the companies having contracts with the Electrical Maintenance and Construction Co. have become involved in legal proceedings through that company's failure to carry out its contract. This company had $0,500 worth of machinery delivered at the Severn by the Jenckes Machine Company, of Sherbrooke, Que. The contractors were unable to go on, and the town took the entire matter in charge. The Jenckes Company took possession of the machinery and shipped on the Grand Trunk, but were stopped at Lindsay by a replevin order obtained by the town. To-day the Master-in-Chambers at Osgoode Hall made an order declaring the defendants to be the Jenckes Company, and striking out the Grand Trunk and handing the machinery back to the town on the depositing of a bond of $9,000. The difficulty between the town, the company and the railway has since been amicably arranged.

FILTER PRESS IN REDUCTION WORKS.

The use of the filtering press has become so general that it is hardly necessary to call attention to or to enumerate the different lines to which its use is adapted. Any product that can be collected or filtered such as paint, varnish, starch, oil, etc., can be economically handled by one of these presses. The opening of the South African gold fields again will cause the erection of stamp mills, which will call into use in that work filter presses. In some of the United States as in Colorado, a great many of these presses are used in this work; some plants having as many as twenty filters. The use of filter presses in reduction works for the rapid separation of materials held in suspension by leaching solutions is becoming more and more valued as reduction works increase in number. In chlorination work the final precipitates are pumped through the press, and retained on the surface of the filter paper, which is afterwards stripped off and burned, leaving the crude values in the ashes, which may be refined afterwards in the usual way. In the cyanide process the precipitates are of a more bulky nature, especially where the precipitation is caused by the intimate mixing of powdered zinc, and the agitation of the leaching solutions, in this case as the precipitate is of considerable bulk, somewhat coarser methods can be followed in filtering. The press may be simply equipped with cloths, which can be scraped from time to time as the chambers fill. We illustrate a press in common use

for chlorination work, manufactured by Wm. R. Perrin & Company, Chicago; this press having division frames between the plates which have corner inlet and outlet, the advantage being to allow the application of filter paper in connection with the filter cloths, which are used for backing. The filter paper cannot be used with the centre feed type of press as illustrated herewith, which press is well adapted for many purposes where bulky precipitates are to be obtained. Presses with the division frames are also used for washing slimes, as it is evident that the chamber may be pumped full of the deposit, and on turning the washing water through another channel, or corner feed, it may be made to pass through the cakes from the surface of one plate to the surface of the plate opposite from which point it will be discharged; in this way most effectually washing the material in the press by presenting an immense surface in a thin layer to the percolating action of the liquid under pressure, which may be run to 150 lbs., if desired. For handling very corrosive substances in chemical works these presses are built with wooden plates and rings, but for the ordinary use of reduction works the iron construction stands remarkably well, and has generally proved more suitable than the wood type of press. In the centre feed press the discharge is through a drip cock at the lower end of each plate; a desirable feature because in case of imperfection in the cloth the particular plate may be cut off at the drip. The corner feed press with division rings may also be equipped in this way with individual discharge for each plate, but the closed delivery with the corner channel is generally preferred. These presses are a valuable feature in any process where rapid filtering is required, as they are built to stand heavy pressure and their uses for these purposes are innumerable. Wm. R. Perrin & Co., Toronto, are now building these presses, and will be pleased to give particulars on application.

LITERARY NOTES.

A paper read before the New England Cotton Manufacturers' Association, at the Boston meeting in April, on the Application of Mechanical Draught to Stationary Boilers by W. B. Snow, Boston, Mass., has been published in pamphlet form by the B. F. Sturtevant Co., Jamaica Plains, Mass.

The reports of the British Fire Prevention Committee continue of great interest. No. 46 recently received gives the results of some experiments in which a woolen curtain of special design and structure (the design being by R. Bugge), was suspended over a door of a room in which a fire existed for 30 minutes; at one time reaching a temperature of almost 1200° F.; the curtain had only one small hole burned in it during this test.

We have before us the proceedings of the Purdue Society of Civil Engineering, Purdue University, La Fayette, Ind., U.S.A., for the academic year 1899-1900.

The bright ideas contained in Charles Austin Bates' little paper, Current Advertising, make it very well worth while for a business man to read.

"Cold Storage," which has reached Vol. III., No. 25, comes to us from the publisher and proprietor, W. J. Richardson, 4 and 5 Great Queen street, London, W.C. The April number discusses a new departure in refrigeration, a mortuary chapel with cold storage chambers, which it is proposed to build in London. This use of artificial cold is already made in Baltimore, Md., where the medical department of Johns Hopkins have a plant, and keep the subjects for the dissecting tables frozen till they are required. As many as 200 bodies are in storage at one time.

The fourth annual report of the Ontario Provincial Instructor in Road-Making is a most interesting little publication, setting out as it does in some fifty pages many of the prevalent defects in road construction, and the easiest and best way to overcome them. A great many illustrations both of bad and good roads are given. The country at large already shows many evidences of the good work of A. W. Campbell, C.E., the Ontario highway man, as he is facetiously called.

We have received Sullivan's New Hydraulics, consisting of new hydraulic formulæ and the Rational Law of Variation of Coefficients, by M. E. Sullivan. It discusses flow and resistance to flow in all classes of rivers, canals, flumes, aqueducts, sewers, pipes, fire hose, hydraulic giants, power mains, nozzles, reducers, etc., with tables and data of cost of pipes and trenching and pipe line construction.

The Summary Report of the Geological Survey Department of Canada for 1899 has just reached us. It contains among others a most interesting description of Sable Island, that great danger to navigation set near the entrance of the Gulf of St. Lawrence. The flora, fauna and topography are described by Geo. M. Dawson, the deputy head and director of the department.

The American Sewage Disposal Co., Boston, John N. McClintock, president, has issued a pamphlet which discusses the validity of the patent belonging to the company, granted to A. S. Glover, No. 550,522, dated May 5, 1896. The claim made in the patent is said to be of such scope as to control the art so far as it relates to the use of primary filter-beds in connection with settling or septic tanks and in which provision is made for the removal of gases and in combination with secondary filter-beds, the contents of the latter of which are to be acted upon by the open air. The roof also, such as is shown in the patent, or any structure over the primary filter-beds, is

not an essential part of the invention described. The opinion of the company's solicitor is given that any arrangement of filter-beds whereby the material to be acted upon is first placed in primary filter-beds, provision being made for the removal of gases therefrom, with secondary beds so arranged with reference to the primary beds as to receive the effluent by gravitation, which effluent is discharged from the primary beds, wholly through filtering material, and so that the effluent may be acted upon by atmospheric air in the secondary beds, is within the claim of said patent, and if made, or used, by any person not authorized by the company, would be an infringement upon said patent.

The law of Canada relating to the manufacture and importation of patented inventions has been for a long time in an uncertain condition owing to the discrepancy between the section of the Patent Act relating thereto and the recorded decisions on the subject. John G. Ridout, of the firm of Ridout & Maybee, patent solicitors, Toronto, undertook to bring order out of the chaos, and was so successful that his Monograph on the subject was awarded a premium by the Chartered Institute of Patent Agents, London, Eng. This society numbers among its members the principal patent agents and solicitors of the world, and it is a decided honor for a Canadian to secure such recognition in competition with men of such high standing in the profession.

The Railway Review, Chicago, has issued a special number reporting the convention of Master Mechanics and Master Car Builders at Saratoga. It contains the pictures of nearly 400 delegates, printed on coated paper, which makes it a veritable photograph album. The publishers have every right to be proud of their achievement.

The Railroad Gazette's special Master Mechanics and Master Car Builders' convention number contains 120 pages. Its contents are very interesting to railway men, and its advertising patronage is monumental. The Gazette's home is New York.

The publishers of the Universal Electrical Directory are preparing a new edition for 1901, being the 20th annual issue. They will be glad to get the names of any Canadian firms who have started business in the past year or two in any department of electrical work. No charge is made for inserting these names. Address H. Alabaster, Gatehouse & Co., 4 Ludgate Hill, London, Eng.

Under Mr. Cooper's editorship The Canadian Magazine is taking rank among the very best periodical literature of America. The June and July numbers are varied enough in contents to satisfy the student, the politician, the military man or the mere reader of fiction.

THE BANK OF TORONTO.

The forty-fourth annual meeting of the stockholders of the Bank of Toronto was held on the 20th June. On motion, William H. Beatty, Esq., was called to the chair, and Mr. Coulson was requested to act as secretary. Messrs. Walter S. Lee and Edward M. Chadwick were appointed scrutineers. At the request of the chairman, the secretary read the following:

REPORT.

The directors of the Bank of Toronto have pleasure in presenting to the stockholders the forty fourth annual statement of its affairs.

The balance at credit of Profit and Loss on 31st May, 1899, was		$115,445 38
The net profit for the year, after making full provision for all losses and deducting expenses, interest accrued on deposits and rebate on current discounts, amounted to the sum of		234,727 44
		$350,172 82
This sum has been appropriated as follows:		
Dividend No. 87, five per cent	$100,000 00	
Dividend No. 88, five per cent	100,000 00	
Taxes paid to Provincial Governments	3,550 00	
Contributed to Patriotic and Red Cross Funds	2,000 00	
Contributed to Ottawa and Hull fire relief fund	1,000 00	
	$207,450 00	
Transferred to Rest account	100,000 00	
Carried forward to next year	42,722 82	
	$350,172 82	

The year has been characterized by increased prosperity and expanding trade, and a marked impetus has been given to the development of the country's resources. The directors have felt justified in transferring $100,000 from Profit and Loss account to the Rest of the bank, making that fund now $1,900,000. The Bank Act is again receiving the attention of the Dominion Parliament, and amendments are being proposed which it is believed will tend to further the efficiency of the Act. As on former occasions, the bank charters are to be extended for a period of ten years. The officers of the bank have performed their duties to the satisfaction of the board. The whole respectfully submitted,

W. H. BEATTY,
Vice-President.

GENERAL STATEMENT, 31ST MAY, 1900.

Liabilities.

Notes in circulation		$1,479,417 00
Deposits bearing interest	$10,055,961 05	
Deposits not bearing interest	2,204,625 45	
	$12,260,586 50	
Balances due to other banks		480,913 24
Unclaimed dividends	$ 200 00	
Half-yearly dividend, payable 1st June, 1900	100,000 00	
	$ 100,200 00	
		$14,321,116 74
Capital paid up	$2,000,000 00	
Rest	1,900,000 00	
Interest accrued on deposit receipts	31,304 00	
Rebate on notes discounted	79,734 00	
Balance of profit and loss carried forward	42,722 82	
	$ 4,053,760 82	
		$18,374,877 56

Assets.

Gold and silver coin on hand	$ 903,401 49	
Dominion notes on hand	1,391,808 00	
Notes and cheques of other banks	309,749 60	
Balances due from other banks	572,472 39	
Deposit with Dominion Government for security of note circulation	80,000 00	
Government, municipal and other debentures	2,661,531 86	
	$ 5,919,053 43	
Loans and bills discounted	$12,250,498 01	
Overdue debts (estimated loss provided for)	5,326 12	
	$12,255,824 13	
Bank premises	200,000 00	
		$18,374,877 56

D. COULSON,
General Manager.

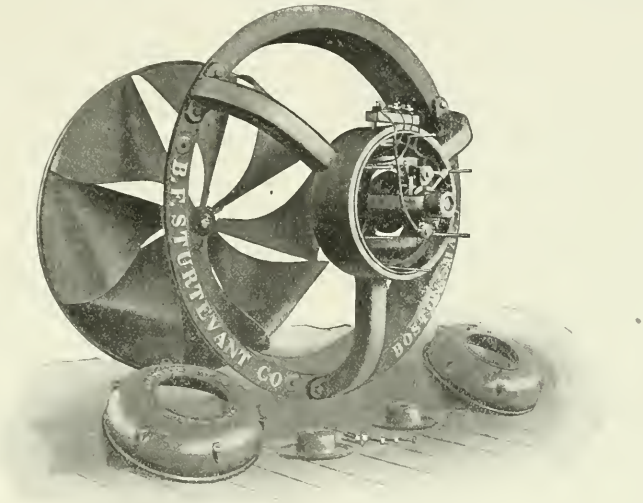
The report was adopted and the thanks of the stockholders were tendered to the president, vice-president and directors for their careful attention to the interests of the bank.

The following named gentlemen were elected directors: George Gooderham, William H. Beatty, Henry Cawthra, Robert Reford, Charles Stuart, William G. Gooderham, George J. Cook. At a meeting of the new board George Gooderham, Esq., was unanimously re-elected president and William H. Beatty, Esq., vice-president.

An electric plant of 600 h.p. has just been installed in the Wellington coal mines at a cost of about $100,000. The electric engines run through about five miles of tunnels, which will shortly be increased by the addition of two more miles. The tunnels have double tracks.

A NEW TYPE OF ELECTRIC PROPELLER VENTILATING FAN.

The B. F. Sturtevant Co., Boston, has during the past year remodelled its enclosed motors designed for direct connection to propeller fans, and is now building a full line of these useful machines, ranging from 18 inches to 120 inches in diameter, with capacities from 2,000 to 175,000 cubic feet in diameter. The motor is of the bi-polar type, entirely enclosed, and thereby protected from dust, a most important element in a machine used under these conditions. In order to avoid the excessive temperature which is incident to the operation of most enclosed motors, this type has been very carefully designed, so that a low temperature rise can be maintained without greatly increasing the size and weight above that of the ordinary open type. This machine is capable of continuous operation for ten hours, with a maximum temperature rise not exceeding 60 deg. F. Yokes extending out from the field ring support the armature shaft. The end casings are entirely independent, and can be instantly removed to give access to the entire interior. The bearings and brushes can be reached by simply removing the caps in the centre of the casings. The brushes are of hard carbon, in holders of a modified reaction type, which allows of easy adjustment when it becomes necessary to reverse the direction of rotation of the motor. The bearings are self-oiling and self-aligning and fitted with composition sleeves, which are removable from the outer ends of the boxes. The design of the propeller wheel is the result of an extended series of comparative experiments with different types. The delivery edge is helical, and the form is such that the air is packed up at the inlet edge of the blade at low velocity, and when well under the influence of the blade is accelerated to its maximum velocity with the least amount of slip. As a result, the efficiency is extremely high. The wheel is partially enclosed within a conoidal inlet ring, which decreases the frictional resistance to the entering air. By means of a tripod support the motor is accurately centered and rigidly held in place, and the entire apparatus may with ease be bolted directly to the wall through which the air is to be discharged. The illustration serves to make clear the general features of the design.



A New Type of Electric Propeller Ventilating Fan

NEW CATALOGUES.

The Detroit Lubricator Co., Detroit, Mich., has sent out a handsome catalogue for 1900, which gives a full description of the lubricators. An interesting chapter tells how this company's sight-feed lubricators work, and goes carefully into the structure of the lubricator, explaining the various parts and their duties in the mechanism. A valuable feature is a page of instructions for the care and operation of sight-feed lubricators, which every stationary engineer should read.

There are over 200 pages of finely printed and well illustrated matter in the new catalogue of the Lunkenheimer Co., Cincinnati, O., U.S.A., makers of brass and iron valves, injectors, whistles, lubricators, oil and grease cups and steam specialties generally. A great deal of useful information is given, and there are a number of tables of properties of saturated steam, decimal equivalents, etc., etc. The volume contains this statement on its last page: "Whenever and wherever you see the above trade mark upon any brass or iron article, you may be absolutely certain that it is the very best of its kind that money and ingenuity can produce. It signifies superior quality, durability and efficiency."

"The Monoline" is the title of a booklet describing the work done by the typesetting machine made by the Canadian Composing Co., of Montreal.

The Cataract Tool and Optical Co., Buffalo, N.Y., has issued an illustrated catalogue of 20 pages, describing its new Precision lathes and attachments in detail, and giving prices of the lathes and all attachments. What can be accomplished by these machines is clearly set forth.

The Philip Carey Mnfg. Co., Lockland, Ohio, send an illustrated booklet about asbestos boiler and pipe coverings, cement roofing, etc.

Those seeking information on pulleys, shafting and rope transmission of power should send for the new 1900 catalogue, issued free by the Dodge Mnfg. Co., York street, Toronto. It is a well bound and well illustrated book of 266 pages, and gives extensive tabulated lists of weights per foot of all the various sizes of shafting, as well as tables showing the horse power transmitted by the different sizes at all speeds. Many up to-date shafting couplings of the latest types are also illustrated, also improved set collars, safety pattern, a complete line of the Dodge Co.'s new ball and socket adjustable hangers, open side, and with all the most modern self-oiling types of bearings. The Dodge patent split friction clutch pulley and clutch couplings are described, with something new in a clutch pulley for powers as small as 1 h.p. The Dodge system of rope driving is well illustrated in many forms, and the Dodge Company are now thoroughly equipped for the manufacture of iron ground rope wheels. Complete dimension tables are appended, making it invaluable to mill architects and superintendents laying out plants.

JOSEPH ALCIDE CHAUSSE.

Joseph Alcide Chausse, the newly appointed building inspector of Montreal, was born in Montreal 32 years ago and studied in the office of A. Raza, a leading architect of Chicago. He was admitted to practice when only 20 years of age, and became one of the founders of the Association of Architects of the province of Quebec, of which he is now a member of the council. He is a member of the Societe Nationale des Architects de France, American Institute of Architects, Societe Centrale d'Architecture de Belgique, International Congress of Architects (Paris, 1900), and treasurer of the Chambre Syndicate de la Construction du District de Montreal.

EXPLORING NEW ONTARIO.

The following compose the officers of the exploring parties now out in New Ontario: No. 1, T. B. Speight, Toronto, in charge; T. G. Taylor, West Gravenhurst; Graham Bell, Toronto, land and timber estimators; R. C. Coulthard, Toronto, and M. B. Baker, B. A., geologists. No. 2, A. Niven, Haliburton, in charge; J. L. Bremner, Admaston; James M. Milne, Queensville, land and timber estimaters; A. G. Burrows, Napanee; D. L. Fralick, Belleville, geologists. No. 3, George R. Gray, in charge; E. E. Sylvester, Sudbury, surveyor; R. Parsons, geologist. No. 4, A. Baird, Leamington, in charge; John McConachie, Huntsville, land and timber estimater; G. Stewart, Toronto, geologist. No. 5, W. S. Davidson, Akron, in charge; Donald Proctor, Walkerton, land and timber man; E. V. Neelands, Toronto, geologist. No. 6, J. M. Tiernan, in charge; J. L. Haines, Utterson, land and timber man; A. H. A. Robinson, Peterboro, geologist. No. 7, H. B. Proudfoot, Toronto, in charge; A. McGillivray, Murillo, land and timber man; F. J. Snelgrove, Toronto, geologist. No. 8, David Beatty, Parry Sound, in charge; John Piche, Copper Cliff, land and timber man; A. H. Smith, Toronto, geologist. No. 9, James Robertson, Glencoe, in charge; D. McPhee, Port Arthur, land and timber man; J. E. Davidson, Toronto, geologist. No. 10, John McAree, Rat Portage, Ont., in charge; John Nash, Rat Portage, land and timber man; John A. Johnston, Toronto, geologist.

ENGINEERS' CLUB OF TORONTO.

The regular meeting of the above club was held on June 5th at the Rossin House as per printed circular notice sent to members. The following members were present: Messrs. Cannift, Chipman, Clement, Cooper, Gamble, Gray, Keating, Killally, Laing, Lambe, Merrill, McDougall, Parke, Rosebrugh, Roy, Speight, Williams, Wickens and Van Nostrand. A. F. Wickson, president of the Association of Architects, was also present. The president telephoned at 8 p.m. that it would be impossible for him to be present at the meeting, and R. W. King was appointed chairman. The meeting was called to order at 8.30, and the minutes of the preceding meeting were read and confirmed. The secretary reported that the directors of the club had succeeded in obtaining signatures to a guarantee fund of over $300 for securing the payments of the rent of the rooms for the next two years. The secretary also reported that the architect's draft plans showing the floor plan of the proposed rooms for engineers and architects, and a longitudinal section of the same, had been handed to him during the afternoon, and that they were now on the table for inspection. After some preliminary remarks had been made by the chairman, Mr. Wickson was requested to inform the club as to the progress the Architects' Association had made towards securing the proposed club rooms. Mr. Wickson stated that the Architects' Association had agreed to take the rooms jointly with the Engineers' Club, each to pay half of the annual rental; the owner of the building to provide heating and a caretaker. After an examination of the plans by the members, and some further discussion, it was moved by Mr. Williams, seconded by Major Gray, "That the draft plans of club rooms as presented at this meeting be approved, and that the special committee appointed for the purpose at the April meeting be authorized to bring the matter to completion, that the rooms may be ready for occupation in time for the first meeting of the club in September." Carried. The topic of discussion for the evening was then announced by the chairman: "Freight Traffic on City and Suburban Tramways." Jas. McDougall led the discussion, and was followed by Messrs. Roy, Keating, Parke, Rosebrugh, Wickens and Lambe. Meeting adjourned at 10.30.

IMPERIAL TRADE NOTES.

A British manufacturer of gauge glasses asks for the names of Canadian buyers of these goods.

A large user of box boards in Britain would be glad to send specifications to Canadian firms able to supply them.

English enquirers want to know location of deposits of copper ore which have not yet been worked to any extent.

A London importer wants the addresses of Canadian manufacturers of wood davits.

A paper agent in London, who has had experience in handling the products of Canadian mills, desires to form a connection with additional Canadian makers.

Enquiries have been made for names of firms in Canada quarrying sandstone on a large scale.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Annual meetings for election of officers have been held by several local branches of the above association. Those reported to date of going to press are as follows:

TORONTO No. 1.—President, J. Huggett; vice-president, W. J. Webb; recording secretary, J. Marr; financial secretary, N. Kuhlman; treasurer, S. Thompson; conductor, W. Butler; doorkeeper, G. D. Bly; trustees, Geo. Mooring, C. Moseley, Jas. Bannon; delegates to convention, J. Huggett, W. J. Webb, H. Terry, A. Storer and N. Kuhlman.

TORONTO No. 18.—President, Thos. Graham; vice president, John Richardson; recording-secretary, Joseph T. Smart; financial secretary, Walter Inglis; treasurer, Peter T. Trowern; conductor, Angus McMartin; doorkeeper, Willis Kent; trustees, J. Hughes, A. Vance, F. W. Fanner; delegates to convention, Joseph T. Smart, John M. Dixon.

HAMILTON, No. 2.—President, Thos. Chubb; vice-president, F. J. Sculthorp; recording secretary, Joseph Ironside; financial secretary, James Carroll; treasurer, W. R. Cornish; conductor, James Wadge; doorkeeper, Thos Cook; delegate to convention, Geo Mackie.

BROCKVILLE No. 15.—President, Wm Robinson; vice-president, John Grundy; treasurer, W. F. Chapman; financial secretary, C. Vanarnum; recording secretary, James Aikins; doorkeeper, Jas. McRitchie; conductor, Victor Hannan; trustees, Ernest Carr, Edward Devine and Matthew Turkington

BRANTFORD No. 4.—No election of officers, and no meetings held recently

It will be remembered that the Montreal branch of the C.A.S.E. seceded from the association last year, and organized a separate branch. The newly adopted name of this body is the "Canadian Society of Engineering," an inconveniently close approach to the title of the Canadian Society of Civil Engineers. The officers elected a few days ago for the ensuing year are: President, H. F. Thompson, first vice president, F. D. Jones;

second vice-president, H. Wady; secretary, W. Smythe; treasurer, Past-President T. Ryan; financial secretary, H. Nuttal; conductor, J. Carr; doorkeeper, H. Knight; trustees, Past President J. J. York, Past President G. Hunt, Past President W Weir. The address of the secretary is care Northern Electric Co. The scope of the new association is broader than that of the old as it embraces marine engineering, electricity, sanitation and even civil engineering is aimed at. The bylaws and constitution are now being framed. It is likely that this association will be unofficially represented at the forthcoming C.A.S.E. convention in Toronto; and the question of reunion will probably be discussed.

NOTES.

Brockville branch reports one new member at last meeting, and meetings latterly have been well attended and interesting. Hamilton branch has had a prosperous year, with a number of instructive open meetings as reported in this journal. One new member recently joined. The secretary, Joseph Ironside, left for a visit to Scotland on the 29th June. Both Toronto branches have had a growing time this year, and look forward to a successful convention.

The annual convention of the C.A.S.E. will be held in Toronto on Tuesday, Wednesday and Thursday, 21st, 22nd and 23rd August, and a programme is now being arranged by the Toronto local committee of which Edward Terry is president, and W. J. Webb secretary. Mr. Webb's address is the Lawlor Building, King street, Toronto.

MORE CONTRACTS.

The supplementary estimates laid on the table of the Dominion House of Commons, include the following items: For the purchase of tools and machinery for the Intercolonial Railway, $66,000; equipping passenger cars on same with Pintsch gas apparatus, $4,800; increase accommodation at Levis, $110,000; additional sidings along line, $105,500; providing travelling steam derricks, $30,000; new steel bridge at Etchemin, additional cost, $22,000; to increase accommodation at St. John (revote, $150,000), $203,000; dredge and blasting rock at Halifax, $11,000; raise Sydney & Louisburg Railway, $3,300; to improve ferry service at Strait of Canso, $250,000; to extend Intercolonial Railway to Copper Crown Works, Pictou, $20,000; rolling stock, $400,000; steel rails and fastenings, $420,000; grain elevator at St. John, $2,000; towards strengthening iron bridges (revote), $80,000; building new and enlarging old engine houses (revote $52,000), $60,000; improvements at Point Tupper (revote), $7,000; towards building sea wall in Cape Breton (revote), $8,000; to provide large turn-tables (revote), $11,000; improvements at Mulgrave (revote), $10,000; towards constructing subway at Christie's Crossing (revote), $3,500; improving telegraph service (revote), $12,000; towards building rest houses at engine stations (revote), $3,000; to provide drop pits (revote), $5,000; total, $1,959,900.

For canals the following is asked among other sums:—Welland Canal, swing bridge across the canal at the fourth concession, Humberstone (revote), $15,000; Lachine Canal, enlargement, $25,000; Trent Canal, construction, $300,000; Rapide Plat Canal, enlargement, $155,000; Cornwall Canal, to repair wharf at Cornwall, $1,000; Farran's Point Canal, enlargement, $60,000; Galops Canal, enlargement (upper entrance), $60,000; Sault Ste. Marie Canal, Hugh Ryan & Co. award and interest thereon, $283,730.68; Welland Canal, general repairs, $30,000; outlet drainage at Port Colborne, $6,000; to renew entrance piers Port Colborne (revote), $20,000; Ottawa River, survey in view of improvement to navigation, $10,000.

Under harbors and rivers a revote of $125,000 for St Andrew's Rapids, Red River, appears. The following items are provided for transportation facilities: Levis graving dock, lengthening dock (revote), $85,000; Montreal harbor (lower division), improvements below St. Mary's current (revote), $300,000; Port Colborne, harbor improvements (revote), $50,000. Depot Harbor, breakwater, $50,000; Sarnia, dredging $11,250. Port Hope harbor, dredging, $5,000; repairs to pier, $2,000—$7,000; Lancaster wharf, $5,000; Cobourg, repairs to pier and dredge, $5,000; Nation River, north branch, purchase of existing riparian rights and removal of dam, parties interested contributing, $2,500; Severn and Black Rivers, improvements in connection with regulation of waters of Lakes Simcoe and Couchiching, $2,500; Beaverton, repairs to wharf, $1,000; Oshawa, repairs to pier provided harbor is transferred to town corporation and that the corporation will agree to maintain it in future (revote $8,000), $10,000; Pickering harbor, repairs to breakwater and dredging, $4,000; Toronto harbor, work in eastern entrance, etc. (revote), $40,000; diversion of Don and dredging the harbor (revote), $25,000; Bronte harbor improvements, $5,000; Oakville, repairs to west pier at mouth of harbor, etc., $5,000; Burlington channel, repairs to piers (revote), $20,000; McGregor's Creek, to pay E. W. Scane in full of his claim for damages caused to property by dredging of creek, $5,000; Rondeau harbor repairs, $1,500, dredging, $3,907.55; Little Bear Creek, dredging (revote), $2,000; Port Burwell, improvement of harbor, $30,000; Port Stanley, wharf, $8,000; Kingsville, repairs and improvements to wharf and breakwater, $15,000; Point Pelee Island, wharf (revote), $6,000; Leamington, pier, $15,000; Sydenham River, dredging (revote), $5,000; Bayfield extension of piers, $5,500; Goderich harbor, reconstruction of breakwater, etc., (revote), $20,000; dredging, to complete (revote), $11,000; Port Albert, dredging, $1,000; Goderich harbor, balance payable to contractor, L. Madigan, including security deposit and interest, $5,039.08; blasting and removing rocky shoal in vicinity of elevator, $4,700; repairs to northern entrance pier, $2,000; Port Elgin, breakwater (revote), $3,000; Port Elgin, dredging, $1,500; Kincardine, dredging, $2,500; Kincardine harbor improvements, $5,000; Wiarton landing pier, $10,000; Southampton, dredging, $2,000; Saugeen River improvements, etc., $5,000; Lion's Head, repairs to pier, $1,000; dredging, $1,500; Owen Sound harbor, dredging and extension of pile protection works (revote, $9,000), $30,000; Oxenden, addition to wharf, $4,000; Meaford harbor, dredging and pile work, $30,000; Thornbury, repairs to harbor works, $1,000; Collingwood harbor improvement (revote, $30,000), $50,000; Barrie, works of reconstruction and repairs on public wharfs, $3,000; Hawkestone wharf (revote, $1,500), $2,250; Midland harbor, dredge, $3,300; Bruce Mines wharf (revote), $8,000; Providence Bay wharf (revote), $5,000; Sheguindah landing pier, $2,300; Sault Ste. Marie harbor improvement, $10,000; Little Current, north channel improvements, $1,000; Port Findlay wharf (revote, $2,500), $5,800; Port Arthur, dredging, $3,500; Desbarats, to complete wharf, $1,000; Hawkesbury, dredging, $4,000; North Bay, repairs, $2,300; wharf on Lake Temiscamingue (revote, $1,000), $3,000; River Ottawa, dam on main channel above the Long Sault Rapids at the foot of Lake Temiscamingue, $5,600; Scugog River, dredging channel (revote), $4,000; River Ottawa, improvement of steamboat channel through narrows of Petewawa, above Pembroke (revote), $7,000; Otonabee River, improvement of navigation (revote, $2,000), $2,500; Indian River, dredging a cut across the Devil's Elbow and also a shoal at Sandy's Landing (revote), $2,000; Kingston graving dock wharves, works of reconstruction and repair, $5,000; Sparrow Lake, widening outlet, $1,700; South Nation River, towards the improvement at the pitchoff, $5,000; Trenton, dredging channel Murray Canal to Central Ontario Railway dock, etc., $8,400; total, $578,297. The sum of $75,000 is asked for a new dredging plant for Ontario and Quebec; $3,730 for a storage battery required for opening and closing the bridge over the Burlington channel, and $50,000 for the construction of a steamer for fisheries and customs protection in British Columbia.

New buildings at Halifax will cost $25,000, while there is $11,000 for a rolling mill for the Quebec cartridge factory, and $25,000 for new military buildings at Ottawa. Brockville, drill hall (revote), $9,000; Deseronto, public building, $5,000; Sarnia, public building (revote $10,000), $15,000; Picton, public building, $13,000; Toronto postoffice improvements, including automobile cars, (revote), $10,000; Toronto Junction, public buildings, $5,000; Toronto custom house and examining warehouse, paving, $4,515; Kingston Royal Military College, additional buildings, gymnasium and hospital (revote), $8,000; Rat Portage, postoffice etc (revote), $16,000; St. Catharines, drill hall (revote), $10,000; Windsor, drill hall (revote $4,000), $15,000; Woodstock, public building (revote), $10,000; Rideau hall, fire protection, renewals,

repairs, alterations, re-metalling, etc., $11,800; St. Thomas, drill hall and armory, $8,000.

For the printing bureau $10,000 is put down for a Webb perfecting press, and $2,000 for envelope machinery. The sum of $2,000 is voted towards the expenses of the visit of the American Institute of Mining Engineers to Canada.

Industrial Notes.

Petrolia is agitating for a pork packing-house.

Lakefield, Ont., has voted to raise $10,000 for the establishment of cement works there.

The Lake Megantic, Que., Industrial Co., with a capital stock of $10,000, has got its charter.

The Geo. McLagan Furniture Co., Ltd., has been incorporated, head office, Stratford, Ont.; capital, $100,000.

The Nova Scotia Steel Co. is putting in a new smelting furnace. The output of the plant will be much increased.

M. & L. Samuel, Benjamin & Co., metal merchants, have moved to their new premises, 27 Wellington street west, Toronto.

F. H. Walker, president of the Walkerville distillery, has visited Montreal to select a site for the new St. Lawrence Distilling Co., of which he is one of the promoters.

The new carbide works, owned by the Bronson Co., at Ottawa, are to be in operation early in August. The works will produce 4,000 tons of calcium carbide per year.

The town of Longueuil, opposite Montreal, contemplates a bonus of $150,000 towards a new cotton factory projected by Louis Simpson, late manager of the Valleyfield cotton mills.

Sault Ste. Marie has passed the bylaw confirming the connection between the town and the Sault Ste. Marie Pulp & Paper Co., Lake Superior Power Co. and allied companies.

The extension of the Barrie waterworks system to Allandale, the adjoining village, is being planned by Willis Chapman, C.E. F. J. Robinson, C.E., of Barrie, will be engineer in charge of construction.

The business of the d'Este & Seeley Co., of Boston, has been reorganized, and a new corporation formed by Mr. d'Este, under the name of Julian d'Este & Co. The company will continue the manufacture of the well-known Curtis Engineering specialties.

The smelting by-law was carried at Kingston June 27th. It grants $4,000 per year for 15 years to the Cataraqui Smelting and Developing Company, which will build works costing over $300,000, and will employ 100 men to smelt at the start 200 tons of ore daily. Building will start this year, and the works will be in operation before the end of next year.

Two large water powers at Lake St. John have been sold by the Quebec Government for $15,000 to a company of American capitalists, who bind themselves to erect pulp factories, workshops, etc., at the Grand Discharge, at a cost of $4,000,000, within four years. The contract has been signed by Hon. S. N. Parent for the Department, and L. T. Haggin, and B. Scott, Mayor of Roberval.

The Acme Machine Co. has been formed at Hamilton for the manufacture of hay baling machines, under the Nixon patents. H. P. Coburn, of the Sawyer Massey Co; John Bertram, of John Bertram & Sons, Dundas; C. S. Wilcox, of the Hamilton Steel & Iron Co., and James M. Young, of the Hamilton Cotton Co., are among the directors. The company expects to commence operations soon.

Jenkins Brothers, manufacturers of valves and 'Jo' sheet packing, have recently added to th ir already well known line of goods a line of extra heavy brass globe and angle valves, suitable for 150 lbs working pressure tested to 800 lbs pressure to the square inch. List prices and discounts will be furnished on application. This firm recently opened a branch office in London to accommodate the demand for their goods in Great Britain.

The Norfolk Distillery Co. is to give a new industry to Port Dover.

The output of the Dominion Leather Board Co.'s paper mill is now four tons per day.

One of the engine and boiler building firms in the Maritime provinces is doubling its plant and capacity.

The Gould, Shapley & Muir Co., Ltd., Brantford, Ont., will double its present staff in a short time, when the manufacture of gas and gasoline engines will be gone into on a large scale.

A. Vincent, A.M. Can. Soc., C.E., has been instructed to make drawings of the filters used at the Longueuil, Que., waterworks to be sent to C. P. Casgrain, superintendent of the Quebec city water department.

A bylaw to provide $203,500 for new buildings and machinery for the Toronto Exhibition will be voted upon July 25th. Boilers costing $4,000, and an engine room for the Machinery Hall, are among the items specified.

A new cannery is to be erected near the Point Atkinson Lighthouse, a company having been incorporated under the name of the Great Northern Canning Co., one of the principal shareholders being E. Spillman, of Vancouver, B.C.

The Society of Civil Engineers of France, June 15th, gave the first of a series of receptions in honor of the delegates from the foreign scientific associations. Among those present were representatives of the Canadian Society of Civil Engineers from Montreal and Toronto.

The incorporation of the National Pulp and Paper Co., with a capital stock of $200,000, and head office at Montreal, is announced. The incorporators are: J. Reid, Quebec; Geo. S. Wilson, Montreal; Wm. R. B. Reid, Indian Lorette; Hon. C. Fitzpatrick, R. A. Becket, Montreal; Dr. F. A. L. Lockhart, Montreal; S. P. Leet, Montreal; M. P. Davis, Ottawa,

The organization of the stove trust mentioned in our last issue has been completed, and it is a much closer combination than that effected some time ago in the furniture trade. A company will be incorporated to take over the control of all the interests of the various companies; chiefly office hands and travellers will be discharged. These Ontario firms are concerned in the movement: Copp Bros., Gurney-Tilden Company, D. Moore Company, Burrow, Stewart & Milne, Bowes, Jamieson & Co., Hamilton; McClary Manufacturing Company, London; Clare Bros., Preston; James Stewart Manufacturing Co., Woodstock; Buck Stove Co., Brantford, and the Smart Manufacturing Company, Brockville.

It is said that the building of the pulp plant at Grand Falls, N.B., has been determined on, and its capacity will be 300 tons of white newspaper, 225 tons of ground wood pulp and 175 tons of sulphite pulp daily, requiring 525 cords of wood a day. The plant will furnish employment for 1,000 hands. The power afforded by the Grand Falls of the St. John river will be electrically developed, and other industries will be established either at this spot or near by. Twelve miles above the falls plans are being made for the manufacture of pulp and various products of hard and soft woods. In this enterprise several prominent men are interested, among them Lord Strathcona, F. Stetson, of St. John, N.B., and Hon. E. R. Burpee, of Bangor, Md.

R. G. Reid, whose vast contracts in Newfoundland have been noticed all over the world, recently proposed to transfer the franchises he holds to a limited liability company, with a capital of $25,000,000. He applied to the Government for permission to effect the transfer—a permission rendered necessary by the terms of his contract with the Government. The Cabinet refused to give its sanction unless Mr. Reid would agree to amend the contract, giving up several very valuable franchises, and a deadlock has ensued. Mr. Reid has suspended all operations except those required under the most literal interpretation of the contract of operating the railway. Hundreds of operatives have been discharged, and the great works will be at a standstill till the Government yields.

The new paint factory in Granby, Que., is having its machinery installed.

A canning factory is being built at Newboro', Ont., to cost about $7,000.

The Kingston locomotive works will be sold by auction on the 10th inst.

Some 150 buildings are now projected or under way in Sydney, C.B., involving an expenditure of $350,000.

Tuerk Bros., Berlin, Ont., are installing machinery in their gasoline engine and automobile factory in that town.

Permits have been granted this season in Winnipeg for $600,000 worth of new buildings and improvements.

The name of the Gillies Bros. Co., Ltd., Carleton Place, Braeside, etc., has been changed to Gillies Bros., Ltd.

Lachine, Que., is discussing the granting of a $35,000 bonus to James Cooper & Co., railway supplies, etc., Montreal.

D. Hibner & Co., Berlin, Ont., will build an addition to their furniture factory. It will be 100 x 44 feet and three stories high.

H. J. Fisk & Co., Montreal, are receiving a bonus of $25,000 for establishing their tannery, employing over 90 men, at Lachine.

The cost of the Spruce Lake waterworks extension in St. John, N.B., has been $169,916 to date, and some further expenditures will be made.

A joint-stock company is to be organized to build a pork-packing factory in Milton, Ont. The farmers in the neighborhood are taking stock.

The bylaw to grant the Dowling and Leighton furniture manufactory a loan of $11,000 was voted on in Harriston, Ont., June 11th, and carried by 13.

The Ontario Government is to remodel the old Victoria University buildings at Cobourg, Ont., this summer, and will use them as an Insane Asylum.

Hamilton, Ont., people subscribed $300,000 to the stock of the Nickel-Copper Co., in a few hours recently. The company is to be capitalized at $10,000,000.

The Hamilton, Ont., city council has adopted the plumbing bylaws proposed some time ago. Building Inspector Anderson is appointed plumbing inspector.

Maritime Province papers refer to a rumored arrangement by which a European firm of the first importance would establish a ship-building plant at Sydney, C.B.

W. J. Sheppard, of the Spanish River Pulp Co., said lately that plans had been completed for the building of the spur from the Sault Ste. Marie branch to the company's mills.

The bylaw to grant a bonus to the Canadian Steel Co., Ltd., the proposed iron company at Welland, Ont., was defeated by a majority of six in the village of Port Colborne, June 8th.

New tenders have been called for for the St. Andrew's rapids work, near Winnipeg, by the Dominion Government. This has been done so that a fair wage clause may be inserted in the contract.

The Waterworks Committee of the Montreal city council recently dismissed J. Fallon, superintendent of the Lagauchetiere street shops, and foreman Thompson of the Point St. Charles shops.

In Brantford, Ont., June 6th, the bylaws for raising of $25,000 for further dyking for flood prevention on the Grand River, and providing for raising by debentures $12,000 for hospital extension, were carried.

The White bolt works, it appears, will remain in London after all. The Guelph Mercury announces that the negotiations between the company and Guelph have been declared off, but adds that the talked of consolidation of the bolt works here and rolling mills there will eventually be effected. Probably so—at London, says the London, Ont., Free Press.

The Southern Review of Commerce, published in Louisville, Ky., U.S., recently referred in the most complimentary manner to the goods manufactured by Jas. Warnock & Co., Galt, Ont., especially recommending the cant-hooks and peaveys.

Winnipeg, Man., will this year issue $50,000 debentures for a public library; also $15,000 for the erection of buildings on the exhibition grounds; $25,000 for a public bathing house, and $65,000 for a bridge across the Red river at the foot of Aberdeen avenue.

The Manitoba Public Works Department will build the substructure of a bridge across the Assiniboine river near the town of Portage la Prairie, consisting of concrete piers and abutments upon pile foundations, and a pile trestle approach about 80 feet long.

Owen Sound, Ont., rejected a bylaw to add $7,000 to the cost of an $18,000 public school on June 12th, but assented to lending $15,000 to W. H. Merritt to aid in starting a furniture factory there, and $6,000 to the Parkhill Basket Co., for starting a branch factory in the town.

The Canadian National Association of Marine Engineers, No. 1 council, at its weekly meeting in Confederation Life building, Toronto, President Craig in the chair, discussed the question of organizing all the Canadian engineers into an effective association for the mutual benefit of the engineers.

J. A. Frigon, St. Prosper; J. A. Frigon, jr., St. Narcisse; A. Massicotte, St. Narcisse; J. Houliston, Three Rivers; W. Donahue, Westmount, Que., have been incorporated as the Shawinigan Falls Brick Manufacturing Co., with a capital stock of $25,000; headquarters at Shawinigan Falls, Que.; to manufacture bricks, drain pipes, lime, cement, etc.

Arrangements are about completed for the reopening of the Broad axe factory, says The St. Croix, N. B., Courier. The new company consists of C. E. Huestis, of St. John, N.B., recently traveler for the Fowler axe works in that city; H. W. Broad and John Wilson, experienced men formerly employed in the old works. They will employ twelve men at first.

A short time ago Geo. H. Hees, Son & Co. bought out the metal-plating and stamping plant of the "H. M. Flock Co.," and they have now bought the entire plant and business of the Excelsior Metal-Plating and Stamping Co. Having combined these metal plants with their own, they have now the largest plant in Canada for making stair plates, curtain pole trimmings, drapery pins, shade pulls, picture hooks and many other articles connected with their window shade and upholstery business. Hees, Son & Co., have factories in Toronto, Valleyfield, Que., and Detroit, U.S.

Brief, but Interesting.

The centre aisle on English railway trains has recently been introduced on the Great Western Railway, says The Engineering News, New York, recently, and the time honored separate compartment system is practically abolished. The partitions between the seats in no case rise to the roof of the car; and in the first-class carriages the passengers are seated two on a seat on each side of the longitudinal centre passageway. The cars are entered from the ends, and another innovation is the use of inside signal cords, running along both sides of the car near the roof. The railway authorities admit that the new arrangement yields a substantial increase of accommodation, as compared with the type of corridor car now in use, with the corridor on one side of the car, and the compartments opening upon it. The old form admitted three on a seat; the new form allows four persons on two seats across the car.

A great mistake is frequently made, both in the commercial testing of gas engines and the guaranteeing of fuel consumption in neglecting to make allowances for the temperature and the pressure of both the gas and the air, says the Gas Engine in a recent issue. These factors are generally overlooked as unimportant, while in point of fact they are of considerable consequence. The pressure and the temperature of the gas as well as that of the air should be reduced to constants which should be adopted as a general standard. It is generally agreed by

engineers that the standard pressure of comparison should be that generally accepted as the atmospheric pressure at the sea level or 14.7 lb. per square inch, and a temperature of either 60° F. or 0° F., usually the former. No better move could be made than the adoption of a standard rating for gas engines by the gas engine manufacturers throughout the United States. Such a rating to be based upon the dimensions of the engine in revolutions per minute, and an average mean effective pressure in the cylinder. This is for the horse-power. For the efficiency of the engine take the suggestion made by Prof. Wm. T. McGruder at the first annual meeting of the National Association of Gas and Gasoline Manufacturers, which is, to base the guarantee upon the number of heat units in a cubic foot of the fuel if it be a gas and upon the number of heat units per pound if it be a liquid.

Railway Matters.

The bylaw granting concessions to the Algoma Central Railway was carried at Sault Ste. Marie.

The two schemes for an air line from the Georgian Bay to Toronto have been thrown out in Parliament. That of the Toronto Board of Trade, the Toronto and Georgian Bay Short Line Railway, died in committee, and the Canada National Railway & Transport Co. being killed by the Senate.

At the annual meeting of the Quebec Central Railway Company, held in London, Edward Dent presided, and in moving the adoption of the report stated that the gross earnings for 1889 amounted to $502,409, or an increase of $52,160 as compared with those of the previous year, while the working expenses had been $334,238, or an increase of $30,330. The net earnings were therefore, $168,171, or $21,830 more; and adding $974 received for interest on temporary investments, the total net revenue was $169,145. After providing for the year's interest paid and accrued on the prior lien bonds and debenture stock, there remained a net revenue balance of $86,495, and, adding the amount brought forward, there was an available balance of $98,698, out of which interest at the rate of 2¼ per cent. had been paid on the income bonds, leaving $24,676 to be carried forward.

The new fast express of the Grand Trunk, the "International Limited," makes the trip from Montreal to Chicago in 23 hours 16 minutes. The run from Montreal to Toronto is made in 7 hours 25 minutes, or half an hour less than the fastest previous record, which was itself a great reduction on former runs. The section from Montreal to Cornwall is now done at the rate of 49 4-10 miles per hour. Making a fair allowance for the fact that the new G.T.R express makes 30 stops, against 16 of the Pennsylvania fast express from New York to Chicago, the Grand Trunk's average time of 37 9-10 miles per hour against the Pennsylvania's 38 4-10 miles per hour, shows a better performance than that of the celebrated U. S. express. For instance the average time from the starting point to Altoona, 327 miles, is 42 7-10 miles per hour, with only three stops; while the Grand Trunk makes 44 91 miles per hour from Montreal to Toronto (333 miles), with nine stops.

Marine News.

The steel steamer "Meteor" has been bought by a Mr McKinnon from Cook Bros., of Cook's Mills. The "Meteor" will be placed on the route from Owen Sound to the Soo.

The Canadian Transfer and Lighterage Co., capital stock, $20,000, headquarters, Montreal, has been incorporated to do a general lighterage business throughout the province of Quebec.

The Electrical Construction Co., Ltd., London, Ont., has completed a contract with the Chatham Navigation Co. for wiring up and completely installing a 100 light electric plant for its boat at Chatham.

Representatives of the Lake Carriers and the Sault Ste. Marie Power Canal Company have made an agreement by which the United States Secretary of War is to be given entire control over the power canal project at Sault Ste. Marie, so far as it may affect the general lake level, and under certain circumstances the secretary is empowered to appoint a board to take charge of affairs and assure protection to the navigation interests.

The statistical report of lake commerce through the United States and Canadian canals at Sault Ste. Marie for the month ending May 31, has reached the Department of Railways and Canals, Ottawa. The statement shows that 2,996,070 net tons of freight passed eastbound through the American canal, as against 271,480 net tons through the canal on this side, or a total of 3,267,550 tons. Westbound, 734,701 net tons of freight passed through the canal on the other side of the line, while 90,146 tons went through the Canadian canal, or a total of 824,847. The aggregate freight east and west in net tons was: American, 3,730,711; Canadian, 361,626. Total, 4,092,397 net tons.

Electric Flashes.

The bylaw for a bonus of $21,000 to the Port Dover, Brantford, Galt and Berlin Electric Ry. was carried in Berlin, Ont., June 1st.

Darling Bros., Montreal, have placed an order with the Electrical Construction Co., Ltd., London, for two 5-h.p. bipolar motors.

The Toronto city council is considering the establishment of a civic telephone service to compete with the Bell Telephone Co., whose franchise has expired.

It is said that McKenzie & Mann will develop the water power at Fort Francis, Ont., on a large scale, and numerous industries will be centred there.

The Times Printing Co., St. Thomas, Ont., has bought from the Electrical Construction Co., Ltd., London, Ont., one 10-h.p. multipolar motor for running presses.

The H. G. & B. Company have offered the big fruit growers of Grimsby and Winona a branch line from Grimsby village to the G.T.R. lines, provided they secure the right of way and the necessary switches.

The Noxon Co., Ingersoll, Ont., has bought from the Electrical Construction Co., Ltd., London, Ont., one 15-h.p. multipolar motor, and states that it is well pleased with the machine.

Berlin, Ont., has accepted the tender of the Berlin Gas Co. for eighty 1,000-c.p. arc lights for an all night and every night service, at $73 per lamp per annum, or 20c. per lamp per night. The tender of Good Bros. was for $125 per annum per light.

The Toronto Electric Light Co. and the Consumers' Gas Co., Toronto, and the Kitson Incandescent Co., have tendered for the street lighting in Toronto, the present contracts with the two former having been completed. The present contract with the city for electric lighting is 20½ cents per lamp per night, or $74.82½ a year. For gas the price paid by the city is $23.50 a year. A tender was sent in by the Toronto Electric Light Co. and an alternative one was made to renew the present contract, under existing conditions, at 19 7-10 cents per night, or $71.90 a year for five years, or 18 cents and $65.70 for a ten years' contract. The other tender of the company was somewhat higher, but included the laying of the wires underground. In its tender, the Consumers' Gas Company substitute the incandescent burner for the ordinary burner. Its tender is $27 a year for a minimum of 800 lights, $25 for a minimum of 1,000 lights, and $50 a year for Lambeth lanterns. The Kitson Incandescent Company tendered against both the Gas and Electric Light Companies but its figures are higher than either. For the Kitson incandescent light, to replace the electric light, $90 a year is asked and for its regenerative hydro-carbon gas lights, $37.50 a year. If, however, the Consumers' Gas Company will sell it gas at market price it will supply this light to the city for $35, where it has to put up posts, and $31, utilizing the present posts. Prof. Rosebrugh of the School of Practical Science Toronto, and R. J. Parke, consulting electrical engineer, will make a report on the quality of the Kitson incandescent petroleum light as against the present street lights.

The electric light plant at Sydney, C B., is being enlarged, and a second chimney put up.

The bylaw for a $3,000 electric alarm system was carried at Woodstock, Ont., June 24th.

Wm. Moore & Sons, Meaford, Ont., have purchased a 1,000 light alternator from the Royal Electric Co.

The Royal Electric Co. is installing a complete factory telephone system for the Cobban Mnfg. Co., Toronto.

An electric railway is proposed to connect Westville, Stellarton, New Glasgow, Trenton, N.S., and the seashore.

The Jones & Moore Electric Co. has recently sold the La Patrie Brick Co., Quebec, a 250-volt generator for its works.

The Jones & Moore Electric Co. has installed a 20-h.p. direct current motor in T. Tomlinson & Son's foundry, Toronto.

The Jones & Moore Electric Co. is installing between 300 and 400 incandescent electric lights in Dick, Ridout & Co.'s woolen mills at Cobourg, Ont.

The Shawinigan Water & Power Co., Shawinigan, Que., is installing a 150-k.w. "S.K.C." twophase inductor generator, purchased from the Royal Electric Co.

The Jones & Moore Electric Co. has just completed the installation of an electric light plant on a steamer for J. & J. Matthews, including dynamo and engine.

The Bowmanville, Ont., Electric Light Co., has had to increase its plant, and has ordered from the Royal Electric Co. a 90-k.w. twophase "S.K.C." inductor alternator.

The Gloucester Telephone Co., Ltd., is being incorporated; capital, $2,000: chief place of business, Bathurst, N.B. R. Ross, J. H. Stewart and C. Ross, Bathurst, are directors.

The new electric railway service between Quebec and Ste. Anne de Beaupre was successfully inaugurated, June 26th, as far as Montmorency Falls. An hourly service is promised.

Mr. Clayton, manager of the Central Electric Co., of Portage la Prairie, while on a trip through the East a few days ago, placed an order with the Royal Electric Co., of Montreal, for one of their 150-k.w. "S.K.C." twophase generators.

In the suit between the Montmorency and Jacques Cartier Electric Light companies at Quebec, Judge Andrews has maintained the right of the latter to carry on business in Quebec city under the charter acquired by it from the Standard Company.

While John H. Poole, engineer, was working last month near the switchboard of the Lindsay Light, Heat & Power Co., his back came in contact with a live wire, which killed him instantly. Mr. Poole, who was unmarried, and 30 years old, was a much respected employee.

The Penetang & Midland Street Railway, Light and Power Co., Penetang, Ont., has greatly increased its incandescent lighting business, and has purchased a 150-k.w. "S. K. C." twophase generator, complete with exciter and switchboard, from the Royal Electric Co.

The Jones & Moore Electric Co. has recently installed electric motors for the following firms: G. T. Pendrith & Co, two; J. E. Hurst, Wm. Ryan & Co., Atkinson Bros., The Vir Co., E. French & Co., Eze Manufacturing Co., all of Toronto: J. B. Dubois, Aylmer, Que., and Donnelly & Dunn, Ottawa.

At a recent meeting of the directors of the Brantford, Ont., Electric and Generating Co it was decided to construct a new fire-proof power-house, near the locks. All the machinery and perishable material will be raised 10 feet above the highest flood level known. The estimated cost of the change is $30,000.

The Woodstock and Ingersoll Gravel Road Co. has missed the opportunity of selling the road to the Woodstock, Thames Valley and Ingersoll Electric Ry. Co., which has now almost finished buying a rod of land from the farmers along the south side of the road for less than $15,000, which was the price demanded by the road company. The land purchased cost the railway company $75 per acre.

The annual meeting of the Ottawa Electric Company was held June 25th. Thomas Ahearn was re-elected president, and J. W. McRae, vice-president and managing director. The annual report showed that so far as the business for the year was concerned, it was in every respect satisfactory. The company was a heavy loser in the fire, owing to which the dividend due in April was not passed.

The Granby Consolidated Mining and Smelting Co., Grand Forks, B.C., is installing a 10-k.w. multipolar direct current generator, purchased from the Royal Electric Co. The Electric Reduction Co., Buckingham, Que., is installing two 25 k.w. direct current generators, supplied by the same company

The Brantford Electric and Operating Co., Brantford, Ont., who has been furnishing arc and incandescent lights and operating motors from a 180 k.w. "S.K.C." successfully for the past four years, are largely increasing their power and lighting business, and have ordered from the Royal Electric Co., a 360-k.w. "S.K.C." twophase machine.

Personal.

D. R. Brown, for thirteen years town engineer of Cornwall, Ont., died there recently at an advanced age.

D. C. Henderson, who organized the Henderson bicycle factory at Goderich, Ont., died last month at his former home in Brantford, aged 45.

F. N. Thomas, machinist, received fatal injuries recently in the Northey Mnfg. Co.'s works, Toronto, by getting his clothing caught in the metal planer.

J. W. Bain, B.A.Sc., fellow in Mining School of Practical Science, Toronto, has been appointed temporarily secretary of the Ontario Bureau of Mines.

W. E. Pilkington, and George Hunt are visiting Toronto with a view to opening an Ontario branch for the Rossendale Belting Co., of Manchester, Eng.

J. Donnelly and J. French were killed in the Victoria nickel mine, Whitefish, Ont., by a log, which had been laid across the shaft to support the bucket, falling in on them.

W. D. Phillips, who has for the past eight years been connected with the Niagara Falls Park and River Railway, and the past five years its manager, resigned June 6th.

F. B. Utley, of the Galt, Ont., Reporter, has won the prize of a fine trip to the Paris exhibition offered by the Dunlop Tire Co., for the best 200 words describing the good points of the tire

George Miller of the E. B. Eddy Co., Hull, Que., has been for some time in the United States looking after the pulp and paper machinery which has been bought to equip the mill now rebuilding.

The Quebec Official Gazette publishes the announcement that the following students of the Montreal Polytechnic School have obtained the diploma of civil engineer: L. E. Cote, St. Hyacinthe, and L. H. Charlebois, Montreal.

Mr. Drouin, stationary engineer in the city hall, Montreal, has been appointed superintendent of the building by the council, and will now be held responsible for the discipline of the building staff, and the care of the establishment generally.

Lieut. Armstrong, son of C. N. Armstrong, the well known railway man of Montreal, has been appointed to the staff of railway construction in South Africa, under Colonel Girouard.

Daniel McGillivray, of Vancouver, the well-known railway contractor, died recently at Sault Ste. Marie, of smallpox. Mr. McGillivray was a contractor on the Rainy River Railway, and had recently taken a contract on the Clergue Algoma Central Railway.

M. Neilson, C.E., general manager of the St. John, N.B., electric railway, who has been for some months superintending electric railway construction work in Jamaica, has been recalled to Canada by the illness and death of his mother, who lived near Almonte, Ont.

R. T. Dickinson, after many years of service as chief engineer at the works of the Hamilton Electric Light Co., has moved to Midland, Ont., where he has accepted a position He was given a surprise at the works, the day before he left when he went around to say good by to his former associates. On behalf of the staff, Gordon J. Henderson, superintendent of lighting, presented Mr. Dickinson with a purse of gold

Dennis T. O'Brien, son of the late D. O'Brien, contractor, Montreal, has been appointed superintendent of the Lachine Canal, succeeding Mr. Conway. Mr. O'Brien was superintendent of the Lake Superior Power Co.'s works at Sault Ste. Marie when he received his new appointment, and had been previous to that foreman of the Montreal harbor works. It is said that owing to political wire pullers the appointment has since been cancelled in favor of another man.

The vacancy in the chair of chemistry, in Toronto University, occasioned by the retirement of Professor Pike last year has been filled by the appointment of William R. Lang, D.Sc., of the University of Glasgow. Dr. Lang, who has held for some years the position of lecturer in organic chemistry and assistant to Professor Ferguson in the University of Glasgow, comes to his new post with very high recommendations. Among those who testify to his fitness may be mentioned; Lord Kelvin, Sir William T. Gairdner, Professor Troost, of the University of Paris, and Professor William Ramsay, of University College, London, the latter of whom speaks in the highest terms of Dr. Lang's qualifications for the position to which he has just been appointed, and who dwells especially on his capacity for organization. Professor Ramsay himself held for some time the lecturership in Glasgow University from which Dr. Lang is being promoted, and has an intimate knowledge of its duties and opportunities for special training, as well as of Dr. Lang's standing as a chemist. Owing to the increasing age and special researches of his superior, Professor Ferguson, Dr. Lang has, it is said, been for some time practically in charge of the work in the Glasgow laboratories.

Mining Matters.

The Dominion Iron and Steel Co recently ordered 100 carloads of timber for mine props.

Work will be commenced shortly by the Island Copper Mining Co., at Simpson's Island, Charlotte county, N.B.

The Great Northern Ry. Co. is making a test of the Crow's Nest coal with the intention of using it instead of the Sand Coulee article, if it proves to be as good as it is said to be.

Eight men were instantly killed and several injured by an explosion of gas in the Canmore coal mines, Canmore, Alberta. One of the miners killed opened his safety lamp in the mine.

Near Desbarats on the C.P.R. a fine deposit of iron ore is reported by Jas. H. Teare. The ledge is said to be 100 feet wide, and to be traceable for five miles. Seven years ago a mine was opened in this neighborhood, and some ore shipped to Hamilton, Ont.

The works done on the nickel and cobalt mine on Calumet Island, Que., in the vicinity of Split Rock, do not appear to J. Obalski, Provincial Inspector, to have yielded satisfactory results. The English Canadian Mining Co. was organized to work this deposit, but it seems to have abandoned its works after taking out a few tons of ore.

The Calumet Island lead, zinc and silver mine was only worked a little during a few months of the past year, the Government report states, with 10 men, the operations consisting chiefly of prospecting. About 350 tons of high grade ore were taken out, mostly from the Russell lot, but none was shipped In addition, there is at the mine a good quantity of ore suitable to concentration.

A strike took place at the Belle Island mines, St. John's Nfld., where 2,000 men are employed, in the middle of June. The Dominion Iron and Steel Company has large hematite deposits there, to supply the iron for the new smelting works at Sydney The Nova Scotia Steel Company has a mine in the same locality, and the miners employed by both companies made a demand for 15 cents an hour, their present pay being 10 cents.

Statement of the shipment of ore from Rossland for the week ending June 2, and for the year to date is as follows: Le Roi, for the week, 4,102 5 for the year, 35,962; War Eagle, for the year, 10,603; Centre Star, for the year, 7,017 5. Iron Mask, for the year, 1,131 5; Evening Star, for the year, 356; Monte Cristo, for the year, 273; I.X.L. for the week, 20 5, for the year, 266, Iron Colt, for the year, 50, Giant, for the year, 42 Totals, for the week, 4,123; for the year, 56,004

Large quantities of iron ore are being taken from the Wilbur mines, on the line of the Kingston & Pembroke Ry. The railroad company has a branch spur from the main line to the mouth of the mines.

A company is being formed to bore for natural gas at Owen Sound. There are indications of gas, and small quantities have been found previously. The promoters are Dr. E. H. Horsey, Owen Sound; A. J. Creighton, E. H. Harrison, William Morrison and H. G. Tucker. The drilling will be done under the direction of Mr. Morrison.

The number of students at the Kingston Mining School has increased rapidly, and there is, it is said, hardly room for the students. The Ontario Government, in view of the necessity for enlarging the buildings and increasing the staff, has increased the grant for this year to the sum of $19,200. For maintenance an increase of $2,500 has been made in the grant, and $5,700 has been given to improve the laboratory. The sum of $2,000 is given for the rental of a new hall. Subscriptions to the amount of $1,100, with the promise of more, have come from friends of the school in New York to improve and increase the apparatus.

The Dominion Coal Co. is completing an immense machine for shipping coal at Louisburg, C.B. Its capacity will be 800 tons an hour. The aggregate capacity for the day will be twelve thousand tons, which is two thousand tons more than the estimated daily shipments for the present season. The machine consists of two immense conveying belts one yard wide and 900 feet long, made of rubber, and one inch in thickness. These belts run upon combinations of rollers and are so arranged that the surface of the belt becomes a receptacle for coal, and on the pier where the coal is to be unloaded into the steamers a way is provided for dumping the coal into the holds of the steamers.

A well known railway official, who recently returned from the Michipicoten district, speaks highly of that harbor as a railway terminus. The one mine, twelve miles from Michipicoten, composed of millions of tons of brown hematite, is worked from the face of the mountain. The railway to the harbor is being equipped with pressed steel cars for conveying the ore. This is shipped to Hamilton, Deseronto, Midland, Montreal and the United States. Two lateral shafts have been run into a second mountain, where there is a continuation of the brown hematite, averaging not less than 65 per cent. The railway is a branch of the Algoma Central, and is intended to connect with the C.P.R at a point near Missanabie, and thence to run on to the Hudson Bay. Villages have sprung up, principally populated by the miners and railway employees, and there is already permanently settled along the railway between 600 and 700 men, most of them in comfortable residences, and none under canvas, while less than a year ago the whole population of the district was represented by two Indian families.

Gold dredging is comparatively unknown in Canada as an industry, but has been established for a considerable number of years and operated most successfully in other countries, particularly New Zealand. According to an article by W. M. McKinnon, C.E., published in the New Zealand Mines Record of March 16, 1900, some twenty dredges were at work on the Clutha River and the Manuherikia Creek, about five miles from the town of Alexander in Otago, when he visited the district a short time ago. In the same publication for February 16, 1900, returns are published for January, 1900, of thirty-six companies or dredges, giving a total result of 3,385 oz., 16 dwts. and 14 grs. for the four weeks ending February 3, 1900, but of these eighteen companies had actually worked four weeks, eleven, three weeks; four, two weeks, and three one week; a foot note also adds that these returns represent only a portion of the gold obtained by dredging, as many private companies and co-operative parties do not publish their yields. From the report of the Minister of Mines for 1898, New Zealand, showing returns from thirteen dredges employing a capital of $200,000, the value of gold obtained is stated to have been $250,000, or after allowing 60 per cent for working expenses, a dividend of 33 per cent on the capital The value per yard of the gravel in the New Zealand rivers appears to be low. The report of the Minister of Mines, for 1897, giving it from six to eight cents, with an average cost of about three cents per yard for working. With gravels having a much greater value we should soon establish a profitable industry in this branch of gold mining in Canada

The Canadian Engineer

VOL. VIII.—No. 4. TORONTO AND MONTREAL, AUGUST, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL.

TRAVELING REPRESENTATIVE: A. W. SMITH.

PHILADELPHIA AGENT: H. E. BURNETTE, 2036 N. 13th Street.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE		PAGE
Alligator Shears	80	Marine News	80
Artificial Heating	69	Mining Matters	84
Catalogues, New	75	Mineral Production of British Columbia	81
Cold Storage	76	Mineral Production of the United States	72
Electric Flashes	83	Mineral Production of Canada	77
Electric Headlight on Locomotive	79	Mica Boiler Covering	72
Fires of the Month	80	Personal	85
Gas, Riche's Method of Producing from Wood	74	Railway Matters	86
Heating, Hot Water	79	Space Advertising	79
Industrial Notes	81	Superheated Water as a Stored Power	68
Lathe, New Precision	74	Tool Supply House, A	75
Lachine Rapids Hydraulic & Land Co	79		
Literary Notes	78		

SUPERHEATED WATER AS A STORED POWER, AND A CONDUCTOR OF HEAT AND POWER.

BY ROBT. W. KING, M.E., M. CAN. SOC. C.E.

The Storage Power Co., of New York, has issued a prospectus of a new scheme by which it proposes to apply to traction purposes power derived from superheated water.

The idea of storing power by superheated water, in tanks, for traction purposes, as referred to in the prospectus, seems to be an outcome of the "Prall" system of conducting heat and power by superheated water through pipes, also referred to in this prospectus. The latter was informally discussed in the Engineers' Club, Toronto, at a recent meeting. The two systems involve widely differing questions, so must, therefore, be considered apart.

As regards the conducting of power and heat through pipes to outlying stations by superheated water, let us compare it with the system of conducting the same by steam, which has already met with success in some places. The most important objects to attain in transmission of power and heat by any method is to avoid loss in its transmission, and to cheapen with due regard to efficiency the cost of the conducting agent. The boilers at the main station have their power or heat in store under two conditions, namely, water heated under pressure, ready to expand into steam, and water heated and already so expanded. The steam system requires pipes of a capacity sufficient to carry the expanded product. The superheated water system carries in smaller pipes the product in its unexpanded form. Since the difference in bulk of the two products (varying according to temperature), may be in round numbers somewhere about as 1 is to 2,000; it follows that in the latter system the size of the connecting pipes will be much less, and consequently their cost, than in the system referred to.

There are, however, other questions. For instance, in order to produce steam for power purposes at an outlying station, enough heat must be carried in the water, over and above normal steam heat, 212 degrees, Fah., to first supply the latent heat required by the steam in its subsequent expansion, and then again enough more to produce the steam pressure desired to be carried, and since the best economy in steam-power requires high initial pressure, the total heat and pressure in the distributing piping must be exceedingly great, presenting questions as to its economical production and maintenance, that have to be considered before a reliable verdict can be given as to the chances of the system being a commercial success. Though I believe it will be found impossible to convey power only, economically, still in cases where the superheated water could be advantageously employed as a heating agent, the power due to its expansion could be obtained without extra cost; thus the superheated water could be used for high temperatures, such as baking ovens require, then expanded giving out power, and the exhaust used for warming of rooms, drying purposes, etc. In the second place, as regards the storage of power by superheated water, let us understand that superheated water means water confined under pressure and heated in that condition to a temperature above that at which it would be possible to heat it under normal conditions, without turning it into steam. When sufficient heat is imparted to it in this condition, on the whole or part thereof being released, it expands in volume proportionately to the heat that has been imparted to it, over and above the normal heat of boiling water; when thus expanding, if harnessed to suitable mechanism, it becomes a source of power and there can be no doubt that machinery or a motor car may be driven thereby. For illustration, imagine an ordinary steam boiler fired until it showed a pressure of 500 lbs. to the square inch. Then if the fire is removed, and allowing that the boiler setting is arranged to prevent any serious loss of heat or power from radiator, you can easily imagine that with 3,000 lbs. of water so heated and protected, an engine can be operated for some space of time by the steam forming from the water as the pressure is gradually reduced. We will not now criticize Mr. Prall's claimed improvement in drawing from the water instead of the steam space of the reservoir; but having shown that his proposition, as a whole, has a practical side to it, let us

examine critically the figures and calculations he has given. It is said in effect, page 21, of prospectus, that in the expansion of 3,000 lbs. of water heated to 500 degrees, Fah., he can develop 36 h.p. hours traction power. This calculation is based on two suppositions, 1st, as I read it (since there are evidently clerical errors in the printing), that one pound of water superheated to 500 degrees and corresponding pressure (which would be nearly 500 lbs. per square inch, according to formulae given in the Peabody steam tables), contains 486 B.T.U. that can be utilized for practical purposes (power, I presume, is meant), and 2nd, that in best steam locomotives with 40,000 B.T.U., (in the boiler, I presume), one horse-power on the drivers can be produced.

(Note.—It is regrettable that in a circular, otherwise so well gotten up, referring to this calculation, the proofs thereof had not been read and corrected by an engineer before being printed).

Now, these suppositions, under certain conditions, may be perfectly correct; but do such conditions exist herein? Using for a basis of measurement the "British Thermal Unit," let us allow as sufficiently accurate for present purposes that a B.T.U. represents the heat imparted to one pound of water in raising its temperature one degree by Fahrenheit scale, which scale has its zero point 32 degrees below freezing. Then in elevating one pound of water from zero to 500 degrees, under corresponding pressure, 500 B.T.U. have been imparted to it, and in allowing it to expand back to a temperature of 14 degrees F., with corresponding pressure, which will be below atmospheric, 486 B.T.U., have been expended in work. This, the first supposition, is therefore a result that must have been accomplished, if at all, in a modern compound expanding condensing engine showing an efficiency of 97½ per cent. as compared with what would be possible were the engine to exhaust into a perfect vacuum. Such an engine is not proposed, nor would it be possible to be used for this purpose. The second supposition refers to results taken from "best steam locomotives." Not to encumber this with too many figures allow me to submit that with an efficiency of 9 lbs. of water evaporated per lb. of coal, it represents in locomotives a consumption of four pounds of coal per h.p. per hour.* Such economy is not usually obtainable in small high pressure engines, which, as a matter of fact, burn from 10 to 20 lbs. of coal per h.p. per hour, actually developed. So if Mr. Prall succeeds in reducing the cost of power to small users to such an extent as this, he will have performed a grand work independent of its applicability to traction purposes.

This criticism raises a very interesting question as to what power would really be obtained from the expansion of 3,000 lbs. of water heated to 500 degrees F., under corresponding pressure and under the conditions explained in the prospectus in answer to which the following is submitted: Using the B.T.U. basis of measurement approximately, as explained, then one pound of water at 500 degrees contains 500 B.T.U.; therefore, 3,000 lbs. contains 1,500,000 B.T.U.; here we must understand that 966 B.T.U. evaporates a pound of water at 212 degrees into steam at 212 degrees; therefore, the 1,500,000 B.T.U. would be required in the conversion of only a part of the water into steam, namely, 1,552 lbs., and there remains the balance of the 3,000 lbs., equal to 1,448 lbs., that would be discharged at the exhaust doing no work, each pound of which represents a loss of 212 B.T.U; therefore, the total loss from water unexpanded will be 306,976 B.T.U., which, deducted from the 1,500,000 leaves 1,193,024 only remaining as available for power. Now let us consider what amount of this may be utilized with engines that are non-condensing. At atmospheric pressure the loss in each pound of steam from exhaust will be 212 B.T.U., therefore, of every 500 used, 288 only are utilized, and the theoretical efficiency will be in this proportion, reducing the amount available as power to 687,182 B.T.U., which divided by 40,000 gives as result 17 h.p. hours that might (barring other losses not here referred to), be obtained with engines of the efficiency represented by the locomotive already mentioned. It being borne in mind that the cylinders are four in number, they will be each of, say, not more than 6 h.p., allowing that the engine efficiency is equal to the locomotive referred to, and no other loss of heat than in the locomotive would occur. We thus have 17 h.p. hours with which to handle a car, and its equipment of 30 tons which equals something over ½ h.p., hour per ton.

For comparison, the following data has been obtained from the Toronto Street Railway, as approximately correct: Their largest cars, to seat 80 persons, weigh, with equipment, 15 tons. The motor power available is 60 h.p. The average power used is 21 h.p. The loss by electric transmission being placed at an outside estimate of about 30 per cent. would give approximately at the rail 15 h.p., which equals 1 h.p. per ton. Next in order is the cost of the power; having already intimated that though 4 lbs. of coal in a locomotive may produce a horse-power per hour, and that in smaller engines the consumption is greater; so in larger engines and especially when condensing, it is less. The large power stations take advantage of this by installing engines of 1,000 h.p. and upwards, reducing their coal consumption per h.p. per hour to two pounds and under. Of course to this has to be added the cost of transmission, but even so, the power produced at the station will, it is submitted, be of considerably less cost than in the method proposed by Mr. Prall.

Thus, from Mr. Prall's own basis for calculations, it is shown to be impossible with superheated water to store even half the power claimed, and which the heat elements used represent, and further that this amount is only obtainable barring other percentages of loss not herein estimated. Further, it depends on the obtaining an economy in small engines not hitherto accomplished, this latter leaving final results liable to a further discount of at least 50 per cent. It is also to be noticed that had the full duty been acquired, the cost of power would be in excess of the cost in power stations, including the losses by electric transmission, and that this loss will be proportionately increased to the further waste or losses above referred to. These are the main points to consider in estimating the chances for the commercial

---

Let us get water feed water 60° F.
efficiency of engine 40,000 B.T.U. = 1 h.p., hour
efficiency of boiler 9 lbs. water from and at 212° F. = 1 lb. coal.
Question: How much coal per h.p. per hour.
1 lb. water = to steam (Peabody's tables) = 1146.6 B.T.U.
deduct 12% to [illegible] = 28.12

1118.48

Then 40,000 ÷ 1118.48 = 36 lbs. water evaporated per h.p., hour, which divided by 9 lbs. water to 1 of coal = 4 lbs. coal per h.p. per hour.—R. W. K.

success of this proposed departure in the storage of power for traction purposes.

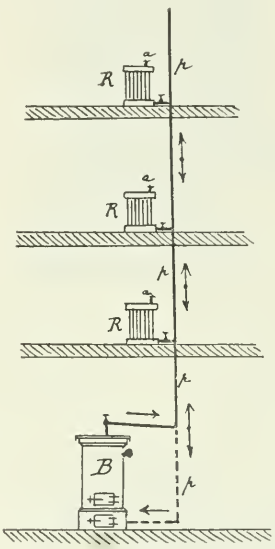
It is not the purport of this criticism to pass judgment so much as to bring out the points that have to be considered. Now we have an Engineers' Club in this city and a School of Practical Science, contributing membership thereto. On behalf of the former the writer has much pleasure in extending to Mr. Prall an invitation to come and discuss the merits of his inventions with us. He will, no doubt, find some "good fellows" amongst the engineering fraternity, and may feel assured of a brotherly welcome, after having converted the club; if he brings his stock book along he may be able to do some profitable business in Canada, where novel inventions are watched with much interest. Take, for instance, the Knap roller boat, built in this city, which Mr. Prall must remember was a product of one of our own inventors, and was backed by Canadian capital.

ARTIFICIAL HEATING.

BY W. M. WATSON.

It is intended to treat this subject as viewed by a fitter. The open fire is a healthy but wasteful method of getting heat. The fault is largely due to the unscientific construction of the mantels and fire grates; the chief aim being apparently to make them ornamental at the expense of allowing hot gases to pass up the chimney and allowing the radiated heat of the fire to be radiated to the mantel jambs rather than into the body of the room. In some grates there is a separate basket, independent of the mantel, and the air of the room can play round it. Usually an open fire consumes as many coals as would answer for six rooms when an economical heating apparatus is used. The conservatories of the old hall at Guisley, England, were heated by running the smoke flues all round prior to passing to the chimney, and dishes of water were hung round to moisten the air. When the place was enlarged, heating by water was introduced, and four-inch cast-iron pipes put in, with troughs cast on them, to hold water, so that the pipes not only did the heating but vaporized water to increase the humidity of the atmosphere. St. Phillip's church, at Girlinton, Eng., built forty years since, was heated by a stove placed in a recess, immediately under the floor near the main entrance, and the flues ran under the aisles to the chancel. The old Kirkbradon church, at Isle of Man, and Patrick Bronté church, at Howarth, Eng., are or were heated in a somewhat similar way. Most of the domestic heating in Germany is done by placing long smoke flues between two brick walls, with the regulating damper at the head: and it takes very little fuel to keep up the temperature needed in such places. To supply open fire grates, lump coal is necessary, while our modern heating apparatus can use small coal that I can remember as waste and unsalable.

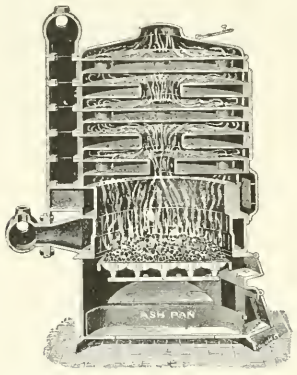
We can now supply heat either by water or by steam at a temperature nearly equal to fire itself. Suppose we take steam at a pressure of 100 lbs. from a boiler and superheat it by compelling it to pass through pipe set in the hottest part of the flue of the same boiler, we then get a dry steam that will, when passed to a radiator, radiate a heat that is useful to heat bakers' ovens and for hot air drying kilns. Steam superheated in this way is used to manufacture water gas, but it is then superheated by another process. Steam at a high pressure and temperature is useful to do heating along with air, and for drying materials of some kinds, but it is too hot to use for direct domestic heating. Steam at a pressure of from one to five pounds, usually named wet steam or low pressure steam, though it is suitable for domestic heating, seems most adapted for stores, halls and factories, because it gives a moderate heat, and the radiators cannot by any neglect get frozen, and should a break occur, there is little damage done to stock or building, because the escape is only vapor and not over hot; besides, the pressure being low, there is a very small risk of explosion.



SHOWING STEAM HEATING BY THE ONE-PIPE SYSTEM.

Perkins' system of heating by water under heavy pressure, caused by using an air-tight expansion tube, or closed tank, which was invented in 1831, makes it compulsory to have a boiler or heater made of the best hydraulic tubing, and the same size and quality of tube is used to radiate the heat in the rooms, making a continuous cycle. In the process of heating, the water expands one twenty-third, by the rise of temperature from 40 deg. to boiling point, 212 deg.; Mr. Jones has proved that 23 gallons would increase in bulk by such heat to 24 gallons. The whole of the pipes in Perkins' system are filled with water, and connected to the expansion tube, or closed tank, which, when the fire is started, is full of air, which is of course elastic, and as the water increases in temperature, in the apparatus, it forces the surplus measure of water into the tank against the air, which compresses the air, and creates a high pressure throughout the whole system; under such a pressure water will radiate heat at an equal temperature to high pressure steam, and have the advantage of the heat being more evenly delivered and being maintained after the fire goes down. This method is also applied to bakers' ovens. Mr. Perkins also introduced a system which he named the medium, in which he placed a relief valve on the closed tank to blow off at a given pressure. A similar apparatus is constructed when we place

radiators that take the heat from our range boilers, or water-fronts, which are coupled with the city pressure. The difference between the two systems is that one is an unknown pressure, practically uncontrollable, and the whole apparatus should be tested to a pressure of 1,000 lbs. to the square inch before it can be considered safe. The medium is a known pressure, that can be dealt with in the ordinary way. The first is a fuel eater and dangerous at the best, requiring special and expensive material to construct it. It may have advantages for some descriptions of heating, but for domestic use it is now superseded by low pressure steam and hot water



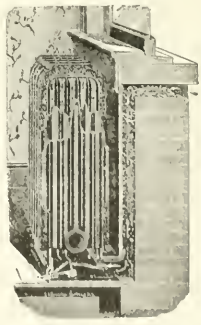
Self-Setting Hot Water Boiler.

systems. The heating by hot water is a very wholesome heat. The system depends for its working on the fact that the heat expands the water sufficient to allow the colder and therefore heavier water to enter the bottom of the boiler, and push the warmer out of the top of the boiler and to the highest point of the flow pipe. It is a principle that is easy to understand and to manage. The act of transmitting heat by hot water is somewhat like syphoning. It is conveying units of heat from a fire to another part of the premises by a rope of water, cased in iron pipe, that turns round in a somewhat similar way that a rope conveys the power of an engine to a counter-shaft. The water in the return is always heavier than in the flow, and it pulls the lighter load after it over the rise of the highest point in the system.

The circulation is often retarded by running the flow pipe round, and serving the radiators as it ascends to the highest point, because as the water cools on the rising side, the speed decreases. Every part of the circulating routes, in the boiler, in the radiators, and supply and return mains, should be smooth and easy of travel, free from intricate passages or sharp throttling turns. The waterways should be thin and nicely proportioned, so that the apparatus will do its work well, with the least possible quantity of water, with a view to facilitate the passage of water over the fire as often as possible. Thomas Chaddock, of England, in his reports of experiments proves that the best results are had when the water passes over the fire at a speed of 175 feet per minute. An apparatus built as here described will free itself from air in every part; the air from every section and every radiator (if properly made), will rise up to the head of the system, and enter the open expansion tank, fixed near, and connected to the highest point of the pipes, and from the tank it will pass to the atmosphere, thus avoiding hand air taps, which are a nuisance.

Heating is often combined with ventilation, either by natural air currents, or currents created by the force of a powerful fan. A fine sanitary arrangement is secured, which promotes good health by adopting what is named the indirect heating system, which may be, by high or low pressure steam, or by hot water. The latter is the acme of domestic heating. It is obtained by placing all the necessary radiating-pipes in a group, in a central position, in the basement of the building. The whole mass of pipes is cased in by a sheet iron box, or by brick work. From the bottom of the box or chamber to the outside of the building, there is a large, fresh air duct, which carries the lowest point of the box underneath the cluster of heaters. As the air warms, it rises between the pipes, and takes up the heat, until the cold air acquires a temperature equal to about 60 per cent. of the temperature of the pipes, and reaches the head of the radiators, and at that point it is divided, and is sent to each room by tin pipes. In this way the air of each room is changed just as often as is considered sufficient. This is an expensive method, but it is the best of all artificial heating, especially if the radiators are heated by water. There is a somewhat similar method of combined heating and ventilating called direct indirect heating, which is really semi-direct heating, which is simply localizing the combined heating plan. To do this a specially constructed radiator is used, having a hollow air space under the heating links at the base. From the hollow box is taken a pipe about 3 inches in diameter through the outer wall of the building which conveys the cold air from the outside under the heater, which warms and ascends up between the heating links of the radiator and enters the room, as in the indirect method. The system is useful because a sick or close bedroom may secure the advantages without going to the expense of combining the heating and ventilation of the whole house.

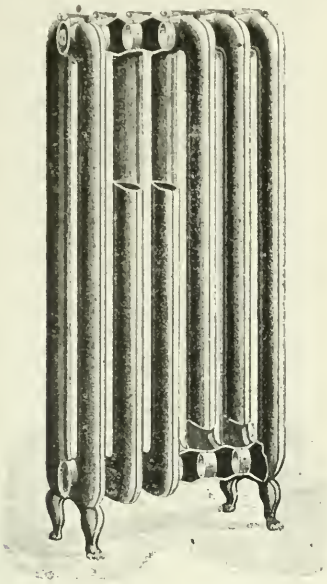
The system of heating by hot air, or air heated by passing over hot cast iron plates, is the cheapest to construct, and the simplest to manage, and probably the least likely to become disorganized or damaged by



Combined Heating and Ventilating for One Room

accident, or inattention; on the other hand it is unhealthy because when fresh air goes near a red-hot plate it loses its humidity, and is unsuitable to breathe. It also carries dust from the furnace to all parts of the house. To improve the dryness, vaporizing dishes are put in, but they are often neglected, and on the whole the system has nothing to recommend it, except the lowness of the first cost of construction, which is only about one-third the amount a hot water or low pressure

steam system would cost. In a building that only requires heat at long intervals, for a couple of hours each time, it is a handy and economical system. This hot air circulating machine is constructed by placing a cast iron stove in the centre of the basement, under the living apartments. The stove is furnished with plenty of wing plates branching from the outside of the stove frame, so that the heat can also be utilized. Besides the

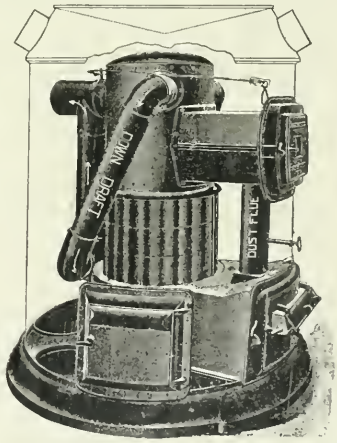


Showing Construction of Radiator with Inlet and Outlet.

heating surface, added by the wing plates attached to the walls of the furnace stove, the smoke-pipe is carried once or twice round the head of the stove in a circle. The stove-pipe circles, the extra wing plates, and the stove itself, are all enclosed in a sheet iron or brick case, in a form which leaves a clear space of about two inches between the inside of the case, and the cast iron stove plates, etc. Into this space a large volume of fresh air is brought from out doors; if economy is pressed, then the cold air from the floor of the rooms the furnace heats is drawn in, in place of the fresh, cold air. The air enters at the bottom of the case, passes over or along the sides of the hot plates, attracts the heat from them, and ascends to the head of the enclosed furnace, and at that point is split up and sent to the rooms by tin pipes.

A natural current of air cannot be forced far away from a rising vertical line, even when the speed and force of motion is increased by heat, when such air is confined and circulating in the interior of a building; there are often rooms to which hot air from a furnace, situated too far away, cannot be coaxed to travel. When this difficulty happens, it can be overcome by adding a hot water heater to the hot air furnace, and creating what is called a hot air and hot water combination heating apparatus. This is accomplished by placing a ring coil pipe heater inside the stove, commencing about level with the top of the fire, and extending upward to the dome of the furnace. This ring of water pipes will absorb as much heat from the fire as an ordinary boiler would from a similar fire of its own, without injuring the heating properties of the air furnace or its appliances. By this combination, both air and water are heated by one fire, thus economizing fuel, and providing the advantage of heating the bedrooms and general living rooms by water, or such rooms as the air will not travel to, and the hall and balance of rooms by the circulating air.

The old method of connecting steam heating radiators at both ends by a flow and return pipe, in low presure systems, is not popular, because it is found that equally satisfactory results can be gained by using flow pipes alone, which is done by connecting them at one end only; this uses less pipe, fittings, and labor. By the one pipe system, the boiler is, as usual, placed at the lowest place in the cellar, and from the top of the boiler the rising main is taken up to near the ceiling; then a quarter bend is used and the flow pipe run at a slightly downward grade, in a circle, round the cellar, and comes back to the boiler, dropped down and connected to the bottom of the boiler. Along this circle pipe there are tees placed at proper intervals, and from the tees vertical branches are taken upward through each story, to the highest flat requiring heat. In each room they are connected to the radiators with short branches. When everything is in working order the steam leaves the boiler at the crown, passes on round the cellar ring, supplying each vertical pipe-line as it passes on its route, and from the vertical pipes, through the short branches, to each radiator; all the time it is traveling, and when in the radiators it is cooling and condensing to water, and this water must go back to the boiler down the same way the steam passes up, and in quite an opposite



Construction of Hot Air Furnace

direction. This is accomplished without friction or noise in the pipes or interference with each other's duty, because the steam chooses to flow up the centre of all vertical pipes without rubbing the walls, and to pass near the crown of a level pipe, leaving the bottom for the water. When the building is, say over seven stories high, it is heated on the overhead system, as a rule, and if sixteen stories high, both the overhead and the rising main system are used, on the same building; the rising main for the lowest half of the stories and the overhead for the top half of the stories. In the overhead system the rising main from the crown of the heater is continued

up to the top rooms' ceiling often as high as 50 yards; then a quarter bend, and afterwards it runs round the room in a similar way as described for the circle of pipe in the cellar; but in this case all the branches run and convey the steam downward from the top room to the basement, and are connected to the radiators from a tee set a little below the level of the radiators, with a short branch rising upward. This is done so that the condensed water from the radiator will fall back and dribble down the falling main. The falling mains all connect to a receiver pipe, below the water line of the boiler, which collects the drip water and conveys it into the bottom of the boiler again. This form of conveying heat is strongly syphonic in action, having a great drawing power which pulls the steam over the saddle bend in the top room, towards the radiators, in the lower stories, and the drip water travels in the pipes the same way as the steam. The system, last described, to my mind, is ahead of the rising system; however, there are buildings that one system will answer, and the other would not. The advantage of the overhead system is that there is a vacuum force created, on account of steam being reduced to water. We are told that a cubic foot of steam makes a cubic inch of water. This is a great reduction in bulk, which causes a pulling downward to bring over and down more steam to fill the vacancy. Allow me to illustrate this principle of working, by relating an incident that occurred with some of my fitting. I had fixed up a large egg-shaped copper still to distil gas acids having an interior measurement of about 70 cubic feet, and placed inside a 2-inch ring pipe heat radiator, heated by high pressure steam. It was put in action, and I was placing another, when I heard a loud report; on looking round to find the cause, I observed that the valuable still was reduced to sheet copper rags, and the pieces drawn tightly into the end of the cooling pipe. The owner thought that a man from his farm was capable of turning off steam and filling the vessel when necessary. He fulfilled his instructions, distilled the acid, and completed one filling, which left the interior filled with steam, and before this vapor had time to condense and reduce in measurement, the attendant closed off every valve in any way connected with the still, and being cold weather, the walls of the still quickly reduced the vapor to water, which created a large vacuum that applied force sufficient to break up the metal the still was made of. Had there been a pipe connected to the still, with the other end dropped below the water line of a well, then as the vapor cooled, and reduced in measurement the water would have been drawn from the well to fill the vacant space, or if the pipe had been connected to the steam drum of a live boiler, then in that case, as the vapor cooled and reduced in measurement, the steam from the boiler would have made the void good. It is a similar action that is constantly going on when steam heating is done by the supply being drawn downward. The steam from the slide valves of an engine is often condensed by forcing it to pass under a cold shower. This reduces the exhaust steam to water, and also reduces it in measurement, which creates a vacuum, and a strong suction on the off side of the cut-off valves, that supplies the steam to the pistons which pull the exhaust steam away. But the cooling process, by using expensive cold water, may be done away with, and the exhaust steam used for heating the factory or drying the materials used in the factory and heating the water intended to be used in the boiler.

(To be continued).

THE MICA BOILER COVERING CO., LTD.

The Mica Boiler Covering Co., Ltd., was formed some five years ago in Toronto to make pipe and boiler coverings. It was said that the market for such commodities as these was pretty well supplied with already well known coverings, but the organizers of the company believed that the superiority of the mica covering had been proved by numerous independent tests, both by practical engineers and by railway corporations, and others, and it was felt that as soon as its merits were known to steam users it would soon get its fair share of the business, Not only were these hopes realized, but in a short time the covering was received with such favor that the factory in Toronto was found inadequate to supply the demands. A company was formed in London, Eng., to take over the business and enlarge it, and they at once opened a large factory in Montreal to better meet the demands in Canada and elsewhere. The factory was opened in Montreal the first of the present year, and has already proved to be too small for the purpose, and it is proposed to secure additional space. Not only is the company supplying great quantities of both pipe and boiler covering for Canada, but every week large shipments are sent to England. Last fall some 10,000 feet were sent to the British Admiralty for use on Her Majesty's yacht, and the lords of the Admiralty have reported that it has given excellent satisfaction. The company is now supplying coverings for many of the large railways in England and Scotland, and it is beginning to be used largely on steamship lines. In Canada the C.P.R. has placed large orders for its locomotives, the Michigan Central Railway (southern division), and the Lake Erie & Detroit River railways have adopted it as their standard lagging. The company states that there is no covering that gives the railways the all round satisfaction that the mica covering does, as it stands the excessive vibration of the locomotives better than others, besides being practically indestructible. The company has now in hand orders for some of the largest buildings in Montreal and vicinity.

In addition to the flexible pipe and boiler covering the Mica Boiler Covering Co. has lately placed upon the market a sectional pipe cover and fire-proof cement. The sectional covering is claimed to combine all the advantages of other coverings now in use together with the superior insulating qualities of the flake mica, thus making it incontestably the most efficient sectional covering offered. The mica cement is designed to meet the demand for a cheap covering for low pressures, and also for fire-proofing. In a test made by the officials of the C.P.R., in Montreal, recently, of some five or six well known cements, in order to decide which was the best for resisting fire, the mica cement was proved to be superior, withstanding the fierce flame directed on it for a far longer time than the other cements. A great quantity of this cement is already in use and is said to be giving the best of satisfaction. The company now confidently claims that with these four lines, flexible boiler mats, flexible pipe covering, sectional pipe covering and fire-proof cement, it is able to give steam users better satisfaction than they can get from any other covering known.

Incorporation has been granted to W. J. Hamilton, T. A Cooley, R. Harrison, J. W. Bennet, A. E. Dixon, H. P. Lindsay, W. H. Hill, Gustie E. Hamilton and P. Alexander, Peterborough, Ont., and J. O. McCarthy, Toronto, as the Hamilton Motor Co., to make and deal in motors for carriages of all kinds, and boats, launches, etc., to be driven by electricity, gasoline, etc. Capital stock, $50,000; chief place of business, Peterborough, Ont.

THE MINERAL AND METAL PRODUCTION OF THE UNITED STATES.

The following statistics of the mineral and metal production of the United States are taken from the very elaborate comparative tables published by the Engineering and Mining Journal, New York, from the advance pages of The Mineral Industry, Vol. VIII., by Richard P. Rothwell:

PRODUCTION OF ORES AND MINERALS IN THE UNITED STATES.

Products.	Customary Measures.	1899. Quantity. Customary Measures.	1899. Value at Place of Production. Totals.
Asbestos	Sh. T.	912	$ 13,860
Asphaltum	Sh. T.	15,660	308,130
Asphaltic limestone	Sh. T.	10,378	54,422
Bitumin's sandstone	Sh. T.	42,104	123,229
Barytes	Sh. T.	32,636	137,071
Bauxite	L. T.	36,813	101,235
Borate of Calcium. *e*	Sh. T.	24,068	505,428
Bromine	Lb.	433,003	125,571
Cement, nat. hydraulic	*g*Bbls.	10,186,447	5,183,500
Cement, Portland	*h*Bbls.	5,805,620	10,441,431
Chrome ore	L. T.	100	1,000
Clay products	.....	.....	74,064,628
Coal, anthracite	Sh. T.	60,577,398	103,648,780
Coal, bituminous	Sh. T.	191,501,350	172,406,679
Coal, cannel	Sh. T.	36,639	91,597
Cobalt oxide	Lb.	10,200	15,810
Copper sulphate. *f*	Lb.	67,903,370	*m* 3,530,975
Corundum	Sh. T.	970	78,570
Emery	Sh. T.	3,000	150,000
Feldspar	L. T.	26,968	137,866
Fluorspar	Sh. T.	24,030	152,655
Fullers earth	Sh. T.	13,620	81,900
Garnet	Sh. T.	2,565	72,672
Grahamite	Sh. T.	3,150	97,650
Graphite, crystalline	Lb.	3,632,608	145,304
Graphite, amorphous	Sh. T.	1,030	8,240
Gypsum	Sh. T.	372,285	1,109,286
Iron ore	L. T.	25,341,000	58,284,300
Lepidolite	Sh. T.	124	4,600
Magnesite. *c*	Sh. T.	2,000	7,600
Manganese ore. *i*	L. T.	143,256	306,470
Mica, serap	Sh. T.	6,917	*o*50,956
Mica, sheet	Lb.	97,586	76,926
Molybdenite	Sh. T.	18	900
Monazite	Lb.	330,000	18,480
Natural Gas	.....	.....	*e*11,500,000
Ocher. *p*	Sh. T.	42,286	465,146
Petroleum, crude	*y*Bbls.	57,234,304	64,143,890
Phosphate rock	L. T.	1,823,391	7,031,785
Precious stones	.....	.....	*e*175,000
Pyrites	L. T.	178,408	583,323
Salt. *q*	Bbls.	19,861,948	5,437,941
Silica, brick	M.	45,000	850,000
Diatom, earth	Sh. T.	1,136	8,216
Flint	Sh. T.	24,305	56,481
Sand, etc	L. T.	*e*850,000	*e*1,338,580
Pumice	Sh. T.	340	1,700
Grindstones	Sh. T.	43,959	501,085
Whetstones	.....	.....	115,220
Tripoli	Sh. T.	2,102	4,729
Slate, roofing	Sq'es.	1,098,374	3,055,988
Manufactures	.....	.....	540,434
Pigment	Sh. T.	4,911	50,338
Soapstone	Sh. T.	20,011	189,504
Soda, natural. *r*	Sh. T.	10,500	152,250
Stone, for building	.....	.....	*e*38,797,487
Stone, limestone (flux)	L. T.	6,707,435	3,475,525
Stone, lithographic	Sh. T.	40	2,000
Strontium sulphate	Sh. T.	*Nil*	*Nil*
Sulphur	L. T.	1,565	33,585
Sulphuric acid. *f. l*	Sh. T.	59,572	1,328,456
Talc, common	Sh. T.	6,671	51,763
Talc, fibrous	Sh. T.	57,120	272,595
Tungsten ore	L. T.	168	*n*33,600
Uranium ore	Sh. T.	43	21,500
Wulfenite	Sh. T.	*(b)*	*(b)*
Zinc sulphate	Sh. T.	528	21,648
Zinc ore, exported	Sh. T.	28,220	725,944
Zinc white. *s*	Sh. T.	39,663	3,331,692
Est. prod. unspecified	.....	.....	5,000,000
Total			$580,836,032

PRODUCTION OF METALS IN THE UNITED STATES.

Products.	Customary Measures.	1899. Quantity. Customary Measures.	1899. Value at Place of Production. Totals.
Aluminum	Lb.	6,500,000	*m* 2,112,500
Antimony	Lb.	2,500,000	241,250
Copper	Lb.	581,319,091	100,916,994
Ferromanganese. *u*	L. T.	219,768	*v*18,350,628
Ferromolybdenum	Lb.	6,000	3,000
Gold	Oz.*w*.	3,391,196	70,096,021
Iron, pig	L. T.	13,400,735	*v*234,725,754
Iridium	Oz.*w*.	56	165
Lead	Sh. T.	217,085	*m* 19,407,399
Molybdenum	Lb.	30,000	37,500
Nickel	Lb.	22,500	*m*8,156
Quicksilver. *x*	Flasks	28,879	1,155,160
Silver	Oz.	57,126,834	34,036,163
Tungsten	Lb.	*e*45,000	*n*54,000
Zinc	Sh. T.	129,675	14,912,625
Total			$496,057,320

SECONDARY MINERAL AND CHEMICAL PRODUCTS OF THE UNITED STATES.

Products.	Customary Measures.	1899. Quantity. Customary Measures.	1899. Value at Place of Production. Totals.
Alum	Sh. T.	27,276	845,556
Aluminum sulphate	Sh. T.	81,805	2,106,479
Ammonium sulphate	Sh. T.	*(b)*	*(b)*
Carborundum	Lb.	1,741,245	156,712
Cement, slag	*h*Bbls	244,757	360,800
Coke	Sh. T.	18,025,256	42,081,002
Copperas	Sh. T.	13,770	108,508
Crushed steel	Sh. T.	337	47,250
Graphite, artificial	Lb.	405,870	32,475
Lead, white. *z*	Sh. T.	103,466	10,812,197
Lead, red	Sh. T.	10,199	1,070,895
Lead, orange mineral	Sh. T.	928	139,200
Litharge	Sh T.	10,020	103,206
Mineral wool	Sh. T.	7,448	85,899
Soda, manufactured. *r*	M. T.	.....	5,925,276
Venetian red	Sh. T.	6,575	121,519
Total			$63,996,969

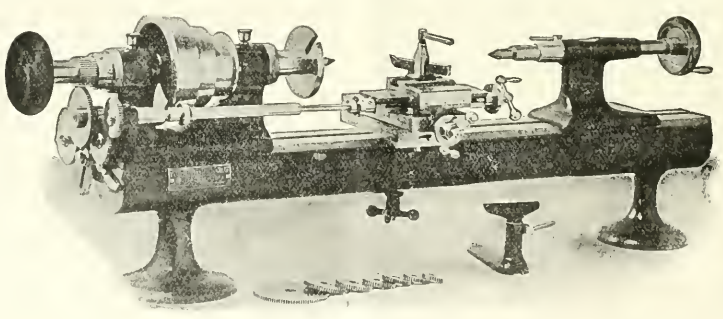
The following notes refer to the three preceding tables: *(a)* Except where otherwise specified. *(b)* Not enumerated. *(c)* Amount or value of crude mineral. *(d)* Partly estimated. *(e)* Estimated. *(f)* Amount recovered as a by-product. *(g)* Barrels of 300 lbs. *(h)* Barrels of 400 lbs. *(i)* Includes manganiferous iron ore; this is not duplicated in the report of iron ore. *(j)* Value per square, i.e., 100 sq. ft., lapped and laid; the weights are calculated on the basis 3 squares = 2,000 lbs., but these figures are only approximately correct. *(k)* Kilograms or per kilogram. *(l)* Reduced to a basis of 66° B. *(m)* Average market price at New York. *(n)* Nominal. *(o)* Value before grinding. *(p)* Includes ocher, umber, sienna and oxide of iron. *(q)* Includes salt used for the manufacture of alkali; the barrel of salt weighs 280 lbs. *(r)* Reduced to a basis of 58% ash. *(s)* Includes a small amount made from spelter. *(t)* Average value of Lake copper at New York, less 0.25c. per lb. *(u)* Includes spiegeleisen, though the total value is reckoned as if the whole product were ferromanganese. *(v)* Average market price at Pittsburg. *(w)* Troy oz. *(x)* Flasks of 76.5 lbs. *(y)* Barrels of 42 gals. *(z)* Includes a comparatively small amount made directly from ores. *(aa)* Not included in the preceding tables.

Abbreviations Sh. T., short tons (2,000 lbs.); L. T., long tons (2,240 lbs.); M. T., metric tons (2,204.6 lbs.)

NEW PRECISION LATHE.

The Cataract Tool and Optical Co., Buffalo, N.Y., places before the public a type of cylindrical bearings which was devised several years ago and has been in continuous use ever since, by the American Waltham Watch Co., during which time it has been found to give results otherwise unobtainable.

Through the introduction of the split and channelled bushings fitted with taper in head, take-up claimed to be readily effected without disturbance of alignment, the end thrust being taken both ways on flat, hardened and ground collars fitted in both ends of head, or upon a special ball attachment fitted to front end of head, as shown in cut of special head. The spindle is hardened and ground throughout, the mouth being finished with 12° taper, for closing spring collets and small step chucks, and the outside ground to standard taper, for taking on large universal chucks and step-chuck closers. In this type of bearing a slight end shake does not disturb the alignment. The bearings are fully protected by closely fitting dust caps. The spindle is especially large, being one inch in diameter and having one and seven-eighths inches cylindrical contact in each bearing of head. The draw-in spindle is provided with vulcanized fibre hand wheel three and one-half inches in diameter, and has capacity for one half inch stock through it. The head is unusually heavy, and allows seven-inch swing over the bed. The cone pulley has three diameters, taking one-inch belt, has two rows of index holes in back, sixty and forty-eight, and either may be used by means of adjustable push pin fitted in head. The front face of cone has four one-fourth-inch holes, forming with large push pin in head a secure and convenient locking device for opening and closing chucks, independent of index pin. The tail stock has long graduated spindle passing entirely through it. The coarser graduations are on spindle, and are read through a central opening in top of tail stock. The feed wheel is graduated to hundredths. The



New Precision Lathe.

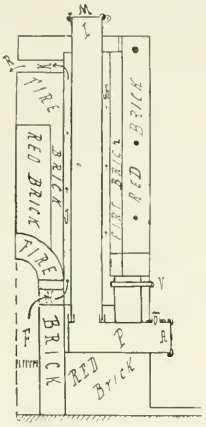
head stocks and tail stocks are all bored in special fixtures. The boring bars are large and heavy, and the alignment, in consequence, is extremely accurate. All parts of these lathes and attachments thereto are fitted to hardened standards, are perfectly interchangeable. The bed is thirty-two inches long, is especially heavy and stiff, the coring for admission of tie bolt of slide rest beginning seven inches back from the left or head end and five inches from the other end. It is faced and T slotted behind for taking on the chasing attachment, is squared and faced on both ends, the left end being drilled and tapped for taking on the screw-cutting attachment and power feed. Thirty-eight-inch beds furnished when desired. The screw cutting attachment consists of a train of gears connected with the slide rest by means of a telescopic shaft equipped with universal joints. A wide range of threads can be cut, either straight or tapering, metric or English system. The attachment is quickly fastened to, or detached from, the lathe; or may be left in position, by dropping connecting link when not in use. The chasing attachment is adjusted to faced and T slotted surface on back of bed, by means of adjustable brackets held in position by eccentric clamp bolts. The tool holder is adjustable along the chasing bar, for operating in any position over the bed. It is provided with adjustable circular cutters, for working both inside and outside, and has finely graduated feed screw with corrugated hand wheel, for ease and accuracy of adjustment. The elevating screw governing rise and fall of tool post has hardened contact point. The raceway is adjustable along the bed to any position, and is hardened and accurately ground. The milling attachment is provided with three finely-graduated feeds, the vertical and cross feeds each having a free movement of four inches, and the parallel feed a two-inch adjustment. All the screws are of tool steel, and are provided with accurately divided check nuts, making the attachment a micrometer tool. The quill spindle takes the same collets as does the lathe, and secures them by means of a draw-in spindle having one-half inch capacity throughout. It swivels on vertical slide, has large circular and finely-graduated bearing, reading 45° both above and below the horizontal position, the upright carrying the vertical slide and is accurately graduated to 45° each way from its center; it is held rigidly in position when set by a large capstan nut and T bolt. All adjustments are capable of take-up, and each attachment is regularly provided with two index dials of forty-eight and sixty. The under side of cross slide is provided with an adjustable stop, for regulating the position of this attachment on bed the same as the slide rest.

RICHE'S METHOD OF PRODUCING GAS FROM WOOD, ETC.

As a great deal of heat is lost in the steam engine, efforts have been made to employ the fuel to greater advantage by converting it into gas and using it to drive gas engines. This has been very successful with coal, but unsuccessful with wood. Since 1780 experiments have been made looking towards the production of a commercially possible wood gas. H. Riche claims to have discovered a process for producing wood gas of high calorific value from wood. This gas is obtained in larger quantities than hitherto, and comes from the gasogene sufficiently pure for use without further purification. In the distillation of wood, no matter what kind of apparatus was employed up to the present, there has been obtained the following three kinds of products: First, the permanent inflammable gases, composed of carbon monoxide and dioxide and hydrocarbons, etc., with a small quantity of nitrogen. Second, the condensable vapors, giving three distinct layers of liquid bye-products. The top layer composed of the light tarry oils, with the benzol, toluene, naphthaline, paraffin, small quantities of phenol and creosote resins, and acetic acid dissolved therein in varying quantities. The bottom layer, composed of heavy oils and tars, laden with acetic acid and a small quantity of phenol and creosotic compounds. The intermediate layer, being composed of a water, in which are found several fatty liquids and acids, formic, acetic, etc., with acetone, acetate of methyl, wood spirit and tarry compounds in solution. Third, a residuum of charcoal in which the amount varied following on the way the distillation had been carried on. In Riche's gasogene the production and distillation repass through its own red hot carbon into the retort. In this way it is claimed that all the wood is decomposed into gas and charcoal.

The generator is a kiln of red bricks and firebricks, as shown in the illustration. One is now working in Paris in the Compagnie des Emeris. Inside the masonry are the beds for the retorts, which are heated by the fire places in which it is stated saw dust and other rubbish may be used as fuel. The firing of the retorts is regulated by a damper which is placed at R, and which is under the control of the gasman. The hot

gases coming from the fire-box F pass through H, and then play around the retort in its bed J1 and J2, and then pass through K away to the chimney. The shape of the retort is P1, and in order to commence operations, it is charged with charcoal or coke up to the mark J1, by means of the hand-door M, and the hot gases from F allowed to play about the retort until it assumes a fine cherry red color, which may be regulated and ascertained by means of the spy hole V When the retort assumes this color it is then ready to be put to work, which is done by simply filling it with wood or other organic substance by means of the hand-door M up to J2, when, due to the high temperature of the retort, the wood or other matter is decomposed into their volatile products, which products rise to the top of the retort I, from which there is no outlet there,

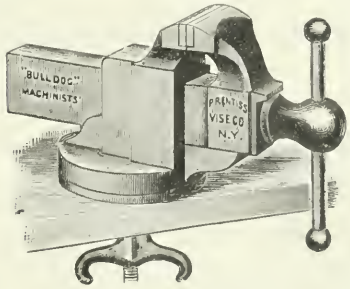


and due to their own pressure have then to return and pass over the highly heated surface of carbon, which exists in the retort below J1, where they are decomposed into the permanent gas Riche, the reaction being accomplished without the introduction of air and consequently without any nitrogen being in the resultant gas, and which gas then makes its way through the opening O to the gasometer. To discharge the retort, is done by simply withdrawing the charcoal or coke through the door A, and to keep the retort in continuous working, only requires to be recharged at the door M. One man is said to be able to look after a generator of six retorts quite easily, and even then has plenty of idle time on his hands.

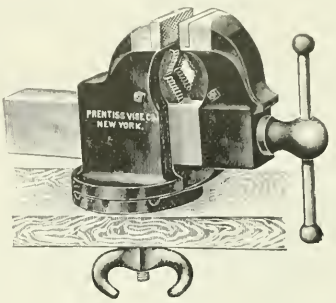
It is claimed that one ton of good chips gives 28,240 cubic feet of gas and 400 lbs. wood charcoal; 900 lbs. of wood is required as fuel to produce this. The French Government about a year ago erected at its cartridge works at Vincenne a generator on the Riche system to supply gas to be used in resmelting the brass required. It is also there being applied for several purposes for which coal and coke were formerly used.

THE PRENTISS VISE CO.

We illustrate with a new pattern solid jaw parallel machinists', blacksmiths' and wood-workers' bench vise, which is



placed on the market under the trade name "Bull Dog." The makers claim that in manufacturing the "Bull Dog" vises only the best of materials, workmanship and improved machinery will be made use of, and in style, finish, strength and durability they believe them to be superior to any vises of this class heretofore offered; and they desire to call special attention of the trade to the following features presented in connection with the "Bull Dog" vises: They are not only of best pattern, best materials, best workmanship and finish, but also are sold at lower prices than any other first-class vise of this kind, and all parts are duplicated on call. This illustration shows the new



Blake pipe vise, embodying many new points heretofore not found in combination pipe vises. It is extra strongly built with a swivel base guaranteed not to slip, and the pipe jaws are reversible. The Fairbanks' Co., of Montreal, carry in stock a full line of the above as well as the regular lines manufactured by the Prentiss Co., and catalogues may be had on application.

NEW CATALOGUES.

Catalogue No. 4, issued by I. C. Fell & Co., 31 Adelaide street west, Toronto, shows a great variety of stencils, stamps, brass seals, rubber stamps and both steel and rubber alphabets and figures. This firm also makes a specialty of brass wheels for picture frame moulding, jewelers' chasing knurls, dies, stamps, etc., soap dies and stamps, steel and brass dies for embossing metals, etc., engraved brass signs, medal and badge dies, etc., pattern plates in metal and wood.

The Jencks Machine Co., Quebec manufacturer of steam and water power plants, mining and general machinery, Sherbrooke, Que., publishes in Bulletin No. 2 a handsome and well illustrated description of the Crocker improved turbine. A large number of pages are devoted to tables and rules for the development of hydraulic power, and there are a great many illustrations showing special features of this company's plants which are reproduced from photographs of the actual installations at St. Jerome, Sherbrooke, Chicoutimi, Fraserville, Danville, Montmagny, St. Narcisse (which supplies lighting to Three Rivers, Que.), Buckingham, Lake Megantic, Que.

We have the Illustrated Catalogue and Price List, No. 11, of the Keystone Mnfg. Co., Schaefer Bros. & Co., proprietors, manufacturers of Imperial ratchet wrenches and combinations, socket wrenches, ratchet drills and ratchet stud drivers, Buffalo, U.S.

A TOOL SUPPLY HOUSE.

To many of our readers no subject is more interesting than that which relates to recent improvements in the way of mechanical tools. The merchant who keeps up to date his stock, and always has the latest device on hand to show his customers is the man who does the right kind of business, particularly if he does not try to force a sale on the customer and just treats him as one interested. The first impression is generally the lasting one, and in no line of business is this more true than in the tool supply trade. We had the pleasure a few days ago of examining a revolving tool case made for exhibition purposes by the L. S. Starrett Co., and purchased from them by D. Drysdale, 645 Craig street, Montreal, who deals extensively in small tools. A short description of this, the first of its kind in Montreal, is here given. It is built triangular in shape heavy glass doors, mounted in quarter cut oak, enclosing a triangular shaped sample board on the faces of which the tools

are tastefully and strongly mounted. Through the centre of the case a rod passes projecting below some six or eight inches, acting as a shaft to revolve the case by means of a small motor connected to same, and concealed under counter or flooring of window. Three strong iron feet act as a pedestal, and Mr. Drysdale will no doubt find the case attract strong attention when in operation. Another point strongly emphasized is the great growth of the mail order department of this concern, and it is now possible from catalogue to make a selection of tools almost as satisfactorily as by personal selection over the counter. We wish to call our readers' attention to Mr. Drysdale's monthly announcements in our advertising columns in front part of our paper. Personal attention will be given mail orders by the head of department, whose long experience will guarantee perfect satisfaction to purchasers.

COLD STORAGE.

Few subjects are of greater importance to Canadian industry than cold storage. By its means the products of our farms, orchards and dairies are enabled to reach distant markets in good condition, and trade in them becomes, therefore, possible and profitable. It is not alone necessary, however, as was at one time believed, that cold storage should be provided on shipboard alone. It is necessary at every point, on the farm, in the cheese and butter factory, on the train, and at the dock. The Dominion Government has made provision for refrigeration on shipboard, and now the Ontario Government is offering a bonus for the establishment of local cold storage warehouses. The introduction of these small warehouses will no doubt make the producers familiar with the great benefits to be derived from a complete system of refrigeration, and lead to the installing of a number of large plants depending on mechanical means to produce the necessary cold. The system recommended by the Ontario Department of Agriculture is that known as the Hanrahan system, which is largely used in the United States. The principles involved are a continuous circulation of air, the evaporation of all moisture and its condensation on the ice in the melting chamber. The odors and gases are also absorbed by the melting surface of the ice. A storehouse, such as is here described, can be built for $210. Plans for larger buildings will be furnished by the Ontario Public Works Department.

Instructions for Erecting Combined Ice House and Cold Storage of the Hanrahan Automatic System.

The sills to be formed of two pieces of 8 x 2 inches laid flat and half checked at the ends and bedded in dry sand, and of such length as will make an oblong 11 feet 6 inches x 17 feet 6 inches. On this sill erect 8 x 2 inch studs at the points, as indicated on the ground plan, and cut off at a height of 18 feet 4 inches for walls enclosing the ice, and 9 feet 2 inches for the walls of the refrigerator chamber, measuring up from the top of the sill. Spike on ceiling joists of 4 x 2 inch to each stud so that the bottom of the joists will be 12 inches below the top of the stud and letting the joist extend so as to give support to the rafters. The rafters to be 4 x 2 inch and to be cut to fit over the top of each stud. The rafters to be covered with 1-inch rough boards and shingles laid showing 4 inches to the weather. The roof ridge to have 5-inch boards and 2-inch roll. The ventilators to be put in, as shown, the large one to be 18 inches square, and the other one to be 15 inches square. The sides to have ordinary louvred openings and the top capped, as shown.

The outside of the studding to be first strapped with 2 x 2 inch, put on horizontally and spaced as shown, then 10 x 1 inch matched boards well and tightly nailed and each joint covered with a 2 inch bevelled batten. The inside of studding to be first sheeted with 1-inch matched boards, then with paper on walls around corners. In fastening paper on wall with tacks about ⅝ inch long, do not drive the tacks home, let them project about half their length, then take a ball of twine, No. 8 cotton, if procurable, or something similar to a ball of thick yarn, not too hard, run this twine over the heads of the tacks, which must be placed so as to have a line of twine directly under the 2 x 1 inch battens to be put on. When the twine is on, then drive tacks home, on the paper, and over the twine place vertically 2 x 1 inch dressed battens, about 18 inch centres, between these battens fix similar ones horizontally over the twine, and about 36 inches apart. These horizontal battens must be cut [illegible] and fitted in tight between vertical pieces, using a mitre box for the purpose. Over these battens lay another layer of paper and twine, put on the same as before over vertical and horizontal battens, then sheet with matched lumber fixed vertically. Over this inside sheeting, place 2 x 1 inch battens vertically about 18-inch centres from floor to ceiling. The ceiling joists to have matched boards nailed to the underside thereof, having three nails to each joist, and the joints to have a batten on the top to prevent the sawdust from working through. The partition between the two chambers to be made with 6 x 2 inch studs, and resting on a sill of one piece of 6 x 2 inch. These studs to be well dressed as the side next to the refrigerator chamber will be exposed. The side next the ice to be sheeted horizontally with 1-inch matched boards, then with paper, and then with another sheeting fixed vertically similar to that used elsewhere. This double sheeting to stop within 10 inches of the ceiling, so as to form the warm air flue, as shown. From the ceiling of the refrigerator chamber up to the top of these 6 x 2 inch studs, put 4 x 2 inch studs, placing them edge to edge with the 6 x 2 inch ones, and so forming the warm air flue 10 inches wide.

Next form that part of the end wall of the ice chamber over the refrigerator chamber, as previously described; this latter to be supported by 4 x 2 inch joists running from the end wall of the refrigerator chamber to the 6 x 2 inch studs of the division partition, as shown in section on line B. B. The underside of these joists to be sheeted with 1-inch sound matched boards, leaving a space 12 inches wide along the end wall of the refrigerator chamber and 10 inches wide along the opposite side. The rafters to have collar ties of 10 x 1 inch, and strips of 4 x 1 inch running therefrom down to the ceiling rafters.

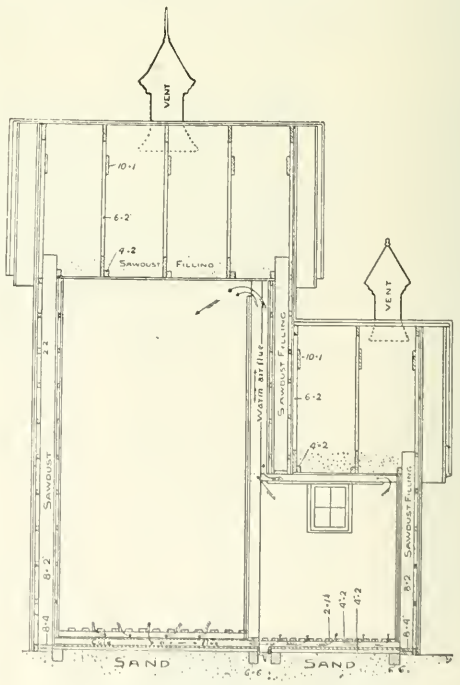


FIG. 2.

The doorway to the refrigerator chamber to be fitted with two doors hung to open out. The frame to have a sill of hardwood, and the doors to be made of two layers of 1-inch matched material with heavy paper between. The windows in this chamber to have 1-inch jambs and head and 2-inch sill in the frames and sash in four pieces, each 1½ inches thick, and glazed with four lights of glass, each 10 x 8 inches, the sash to be put in with stops. The doors in the ice chamber to be made to match the outside sheeting, be hung to open out, and be in a series of three doors, each 4 feet high, and starting 4 feet above the ground level.

Movable 1-inch boards to be put on inside to keep the sawdust in place, as it is packed in as the ice is placed in position. Small batten doors to be put in in the front gable of the ice part, and in the end gable of the other part to give access to the spaces above the chambers. The floor of the ice chamber to consist of 4 x 2 inch pieces laid flat on 6 x 6 inch sills and bedded in sand, and carrying a floor of 1-inch matched boards having a fall of 1-inch towards the drain; on this floor place eight pieces of 4 x 2 inches, as shown on edge, and directly over the first pieces; on these joists lay another floor of 1-inch matched lumber, leaving a space of 1-inch next the dividing partition and another one of 12 inches in the centre running the full length of the ice chamber, as shown. Upon this floor lay 3 x 2 inch joists directly over the others, and thirteen pieces of 4 x 2 inches laid flat and at right angles to the 3-inch strips, the first piece next the dividing partition to be against the wall and the remainder evenly spaced. Upon this lay the ice supply. The floor of the refrigerator chamber to have 4 x 2 inch strips on 6 x 6 inch sills, and bedded in sand, and carrying 1-inch flooring, laid with a fall of 1 inch towards the drain, then 4 x 2 inch strips on edge carrying fifteen pieces of 2 x 1½ inches, evenly spaced and at right angles. This lattice floor to be made in sections convenient for lifting up. A box drain to be formed of 1-inch material and laid with a fall of 3 inches from one side of the building to the other and discharging into a pipe having a trapped inlet below grade and protected by a box cover. All the spaces around the studding to be firmly packed with dry sawdust, and all ceilings to have at least 14 inches of sawdust as a cover, as shown by the drawings. Particular care must be taken to have the sawdust well packed and from time to time go over it and press down tightly. The timbers touching the ground must be well bedded in dry sand, and the sand filled in so as to leave all tight and free from any air spaces between the ground and the first floor laid. The outside of the building to be well packed with earth at least 15 inches high. The inside walls of the refrigerator chamber to be given two coats of good grain shellac. Three nails should be used to each joist or stud. All paper used to be heavy "Sulphite," as made by The E. B. Eddy Co., of Hull, or of similar quality. The sheeting in the refrigerator chamber to be about 6 inches wide.

The building to be located on a well drained site, and where possible with the gable of the ice house facing the south. The plans and specifications must be strictly adhered to in order to obtain the best possible results both in saving products and ice.

Bill of Materials Required for the Erection of a Combined Ice House and Cold Storage Building, as per Plans. Series "A." Hanrahan Automatic System.

Four pieces, 6 in. by 6 in. by 10 ft., sills; 2 pieces, 8 in. by 2 in. by 10 ft. 10 in., bottom wall plates; 2 pieces, 16 ft. 10 in., bottom wall plates; 16 pieces, 18 ft. 4 in., wall studs; 6 pieces, 10 ft. 1 in., wall studs; 14 pieces, 9 ft. 2 in., wall studs; 8 pieces, 4 in. by 2 in. by 14 ft., ceiling joists; 6 pieces, 7 ft. 9 in., ceiling 2 in. by 10 ft. 10 in., bottom wall plates; 2 pieces, 16 ft. 10 in., 4 ft., collar ties; 8 pieces, 4 in. by 1 in. by 6 ft., collar ties; 3 pieces, 5 in. by 1½ in. by 14 ft., ridge cap; 6 pieces, 2 in. by 6 in. by 16 ft. 8in., for division partition; 1 piece, 10 ft., for division partition; 6 pieces, 2 in. by 4 in. by 9 ft. 6 in., for division partition; 8 pieces, 3 in. by 2 in. by 9 ft. 6 in., ice chamber floor; 8 pieces, 9 ft. 4 in., ice chamber floor; 8 pieces, 3 in. by 2 in. by 8 ft. 8 in., ice chamber floor; 13 pieces, 4 in. by 2 in. by 9 ft. 8 in., ice chamber floor; 8 pieces, 6 ft., refrigerator chamber floor; 8 pieces, 6 ft. 4 in., refrigerator chamber floor; 15 pieces, 2 in. by 1½ in. by 9 ft. 6 in., refrigerator chamber floor; 6 in. by 1 in. by 110 ft., cornice; 4 in. by 1 in. by 110 ft., cornice; 21 ft., ridge roll; 600 sq. ft., 1 in., rough boards; 5,000 shingles; 2 ventilators; 700 lin. ft., 2 in. by 2 in., outside strapping; 700 lin. ft., 2 in. by 1 in., inside strapping, dressed; 1,500 lin. ft., 2 in. by 1 in., bevelled battens; 35 pieces, 2 in. by 1 in. by 16 ft., ice house battens; 1 door, 2 ft. 8 in. by 6 ft. 6 in. high, to refrigerator chamber; 1 door, 2 ft. 11 in. by 6 ft. 6 in. high, with frames to suit; 3 doors, 2 ft. 10 in. by 4 ft. high, to ice chamber; 1 door, 2 ft. 10 in. by 3 ft. 3 in., to lofts; 1 door, 2 ft 11 in. by 4 ft., to lofts; 2 window frames and 8 pieces glazed sash, to refrigerator chamber; 3,500 sq. ft. of 1 in. sheeting, for walls, floors, ceilings, etc., etc.; 2,000 sq ft of paper; sawdust for filling; shellac, for walls of refrigerator chamber; hardware, such as nails, screws, hinges, bolts, etc., etc.

SUMMARY OF THE MINERAL PRODUCTION OF CANADA IN 1899.

This summary of the mineral production of Canada for 1899 is published by the Geological Survey of Canada, and is subject to revision in later reports.

Metallic— Product.	Quantity. (a)	Value. (a)
Copper (fine, in ore, etc.) (b) lbs.	15,078,475	$ 2,655,319
Gold, Yukon district	$16,000,000	
Gold, all other	5,049,730	
	.....	21,049,730
Iron ore, tons	77,158	248,372
Lead (fine, in ore, etc.) (c) lbs.	21,862,436	977,250
Nickel (fine, in ore, etc.) (d) lbs.	5,744,000	2,067,840
Platinum, oz	55	835
Silver (fine, in ore, etc.) (e) lbs.	3,078,837	1,834,371
Total metallic		$28,833,717
Non-Metallic—		
Arsenic, lbs	114,637	4,872
Asbestus and asbestic, tons	25,285	483,299
Chromite, tons	1,980	23,760
Coal, tons	4,565,993	9,040,058
Coke (f) tons	100,820	350,022
Felspar, tons	3,000	6,000
Fire-clay, tons	599	1,295
Graphite, tons	1,220	16,179
Grindstones, tons	4,511	43,265
Gypsum, tons	244,566	257,329
Limestone for flux, tons	53,202	45,662
*Manganese ore, tons	308	3,960
Mica	.....	163,000
Mineral pigments—		
Baryta, tons	720	4,402
Ochres, tons	3,919	19,900
Mineral water	.....	100,000
Moulding sand, tons	13,724	27,430
Natural gas (g) tons	.....	387,271
Petroleum (h) bbls	808,570	1,202,020
Phosphate (apatite), tons	3,000	18,000
Pyrites, tons	27,687	110,748
Salt, tons	57,095	234,520
Soapstone, tons	450	1,960
Structural Materials and Clay Products—		
Cement, natural rock, bbls.	131,387	$ 119,508
Cement, Portland, bbls.	255,366	513,983
Flagstones	.....	7,600
Granite	.....	90,542
Pottery	.....	200,000
Sewer pipe	.....	161,540
Slate	.....	30,406
Terra-cotta	.....	220,258
Building material including bricks, building stone, lime, sands and gravels, and tiles	.....	4,250,000
Total structural materials and clay products	.....	5,596,843
Total all other non-metallic	.....	12,544,952
Total non-metallic	.....	18,141,795
Total metallic	.....	28,833,717
Estimated value of mineral products not returned	.....	300,000
Total, 1899	.....	$47,275,512
1898, total	.....	$38,061,040
1897, total	.....	28,661,430
1896, total	.....	22,584,513
1895, total	.....	20,639,964
1894, total	.....	19,931,158
1893, total	.....	20,035,082
1892, total	.....	16,628,417
1891, total	.....	18,976,516
1890, total	.....	16,763,353
1889, total	.....	14,013,913

*Returns incomplete.

(a) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(b) Copper contents of ore, matte, etc., at 17.61 cents per lb.

(c) Lead contents of ores, etc., at 4.47 cents per lb.

(d) Nickel contents of ore, matte, etc., at 36 cents per lb.

(e) Silver contents of ore at 59.58 cents per oz.

(f) Oven coke, all the production of Nova Scotia and British Columbia.

(g) Gross return from sale of gas.

(h) Calculated from inspection returns at 100 gals. crude to 42 refined oil, and computed at $1.48 2-3 per bbl. of 35 imp. gals. The barrel of refined oil is assumed to contain 42 imp. gals.

The progress, etc., of the several mineral industries in comparison with 1898, is shown below:

Product	—Quantity— Increase.	Decrease.	—Value— Increase.	Decrease.
	p. c.	p. c.	p. c.	p. c.
Metallic—				
Copper	....	15.04	24.84	....
Gold	....	....	52.81	....
Iron ore	32.25	....	62.56	....
Lead	....	31.50	....	18.99
Nickel	4.10	....	13.56	...
Silver	....	30.85	....	29.28
Non-Metallic—				
Asbestus	6.30	....	....	1.61
Coal	9.43	....	9.94	....
Coke	15.09	....	22.38	....
Cement	54.57	....	59.34	....
Gypsum	11.54	....	10.67	....
Natural gas	....	....	20.22	....
Petroleum	6.62	....	13.21	....

In copper, owing to the large advance in prices, there was a marked increase in value notwithstanding the decrease in the output. The main features of the industry consisted in decreases in the production of the Quebec and Ontario mines, for, although in the latter case the amount of ore treated was greater than in 1898, the content of copper was lower. The shipments of ore from the Parry Sound district, although small, constitute a new feature in this industry. In British Columbia there was a large advance in the production, chiefly from the Rossland mines.

The value of the gold production shows a large percentage increase in the Yukon and Ontario especially, the former having grown 60 per cent. and the latter over 58 per cent. In the case of iron ore, the large advance shown was only to be expected from the great demand which arose and in view of the growth in the last few years of the iron smelting industry of the country.

The increase in the quantity and value of the nickel produced, attests the continued prosperity of the mines of Sudbury, Ontario, notwithstanding their decreased output of copper as mentioned above. Of the chief contributors to the total mineral production of the country, lead and silver are the only two showing a considerable falling off, and that notwithstanding more favorable prices. This is due to local causes in British Columbia, not dependent on the value of the deposits, but which have led to the restriction of operations there.

With the exception of a slight falling off in the value of the asbestus, all the other chief minerals show considerable advances, both in amount and value. Inspection of the figures shows this especially to be the case in the cement and coke making industries.

LITERARY NOTES

A couple of very interesting books have been issued by Norman W. Henley & Co., 132 Nassau street, New York. One is Horseless Vehicles, Automobiles and Motor Cycles, operated by steam, hydro-carbon, electric and pneumatic motors, by Gardner D. Hiscox, M.E., author of "Gas, Gasoline and Oil Engines" and "Mechanical Movements, Powers, Devices and Appliances." Large 8vo., 450 pages, 346 illustrations, bound in cloth, price, $3; prepaid to any address. This is a practical treatise for automobilists, manufacturers, capitalists, investors, promoters and everyone interested in the development, care and use of the automobile. This work is written on a broad basis, and comprises in its scope a full description with illustrations and details, of the progress and manufacturing advance of one of the most important innovations of the times, contributing to the pleasure and business convenience of mankind. The make-up and management of automobile vehicles of all kinds are very liberally treated, and in a way that will be appreciated by those who are reaching out for a better knowledge of this new era in locomotion. This book is very fully illustrated with various types of horseless carriages, automobiles and motor cycles, with many details. It also contains a complete list of the automobile and motor manufacturers with their addresses, as well as a list of patents issued since 1856 on the automobile industry. Another interesting book, published by Norman W. Henley & Co. is Gas Engine Construction, a practical treatise describing in every detail the actual building of a gas engine, by Henry V. A. Parsell, jr., member A. I. Electrical Engineers, and Arthur J. Weed, Mechanical Engineer; large 8vo., fully illustrated, nearly 300 pages, bound in cloth; price, $2 50; prepaid to any address. This book treats of the subject more from the standpoint of practice than that of theory. The principles of operation of gas engines are clearly and simply described, and then the actual construction of a half-horse power engine is taken up, step by step, showing in detail the making of a gas engine. First come directions for making the patterns; this is followed by all the details of the mechanical operations of finishing up and fitting the castings. This is profusely illustrated with beautiful engravings (see specimens of the engravings on third page of this circular), of the actual work in progress, showing the modes of chucking, turning, boring and finishing the parts in the lathe, and also plainly showing the lining up and erection of the engine. Dimensioned working drawings give clearly the sizes and forms of the various details. The book closes with a chapter on American practice in gas engine design and gives simple rules so that anyone can figure out the dimensions of similar engines of other powers.

P. S. King & Son, 2 and 4 Great Smith street, Westminster, London, S.W., publishers of The Engineering Times, for several months past have been preparing a special issue of The Engineering Times, dealing particularly with the engineering exhibits of every nation represented in the Paris Exhibition. This magnificent number will be published in August, and will be received with interest all over the world. It is worth noting that The Engineering Times is the only English engineering magazine displayed at the Paris Exhibition, as the Canadian Engineer is the only Canadian engineering journal similarly displayed. But then the Canadian Engineer is the only Canadian journal devoted to engineering published, so it cannot claim any virtue in being alone in Paris.

The report of the delegates of the Canadian Manufacturers' Association to the fifth annual convention of the National Association of Manufacturers of the United States has been published in pamphlet form. The discussions in the meeting brought out some interesting facts. In connection with parcels post, it was strongly urged that there were required greater facilities for the conveyance of small parcels. Thus England to-day has parcels post arrangements with over two hundred countries, islands and different places, and so a merchant from Australia complains that it costs him $9 to send a small package of samples to the United States, when he can receive it from England for $1.

The Journal of the New England Waterworks Association, Vol. 14, No. 4, has reached us from the office of publication, 3 Mt. Vernon street, Boston. Among the papers published are: The Albany Water Filtration Plant, by Allen Hazen; Mechanical Filtration, by Edmund B. Weston, and Electrolysis, by E. E. Brownell, etc.

There is, perhaps, but a single place in the country where almost all the newspapers of the United States are read. To the Exchange Bureau of The Ladies' Home Journal practically every paper in the country comes—an aggregate of nearly 9,000.

The Transactions of the Association of Civil Engineers, Cornell University, has been sent us. This is Vol. VIII. of this excellent series and contains a number of papers of considerable interest to members of the profession.

The McGill University Calendar for 1900-1901 announces that the college session for next year will begin on Sept. 4. The

regular lectures in law will commence on the following day. On Monday, Sept. 17, the matriculation, scholarship, exhibition and supplemental examinations, in the faculties of Medicine, Science and Arts will begin. The lectures in Medicine begin on Sept. 20, and in Science and Arts on Sept. 25. The most important feature of the calendar is the statements in reference to the new curriculum for the third and fourth years in Arts, which will go into force next session, in which extensive options will be allowed the students. Each student will select from a very extensive field of studies, six courses, three of which will be taken up in the third year, and the other three in the fourth year. Each of the lecture courses will comprise not more than four hours a week, with collateral reading, and, in the case of subjects in sciences, laboratory courses. One subject which is chosen in the third year must be continued in the fourth year.

We are indebted to E. Gilpin, jr., inspector of mines for Nova Scotia, for a copy of the Gold Measures of Nova Scotia and Deep Mining, by E. R. Farbault, B.Sc., of the staff of the Geological Survey of Canada. This valuable little volume also contains a number of papers bearing upon Nova Scotia gold mines. It is edited and published by the Mining Society of Nova Scotia, Halifax, N.S.

The publishers of The Canadian Manufacturer are to be complimented upon the special tariff number containing the text of the tariff acts now in force in Canada, Great Britain, Newfoundland and the United States. The tariff of each country is fully indexed for ready reference, and the whole work appears to be carefully done. There are about 100 pages of tariff matter, and we are glad to note that the issue is generously patronized by advertisers, Canadian manufacturers being prominent. The issue contains in all 204 pages, and is altogether creditable to Mr. Cassidy's enterprise.

The Marine Review, Cleveland, O., is just issuing the fifth edition of the Blue Book of American Shipping (a marine and naval directory of the United States). It contains a resume of naval and merchant ship construction during the past year, and also of the progress of the shipbuilding industry throughout the United States.

ELECTRIC HEAD LIGHTS ON LOCOMOTIVES.

The Grand Trunk Railway has made an important innovation by fitting its passenger train locomotives with an electric light equipment. One of the large type of passenger locomotives constructed at the Point St. Charles works of this company is now at work in the Montreal and Portland night passenger service, which has, in addition to all the well-known modern appliances of merit for the safety and convenience of train operating, a powerful electric lighted head lamp and a number of incandescent lamps, which have been placed in the cab of the locomotive for the purpose of lighting the steam and air pressure and water gauges, the classification train signal lamps are also electrically lighted a number of other lamps are situated over the machinery of the locomotive for the purpose of better inspection. This new departure of the Grand Trunk in equipping their locomotives has veritably turned night into day. On account of the brilliancy of the headlight, the engineer can very readily distinguish objects within the right of way for over half a mile in advance of a rapidly running train, thus, if necessary, enabling him to have ample distance to stop the train without difficulty. There has been a marked improvement in railway car lighting within the last few years, the oil lamps being gradually superseded by gas-lighted trains, and now the gas has a competitor in the shape of electricity. The lighting of locomotive head lamps has passed through somewhat of an evolution. It has, however, been determined that the success of electrically-lighted locomotives are an accomplished and an established condition on some of the most important railroads of the United States, consequently the Grand Trunk Railway people have decided to apply the system to their line. A more technical description of the mechanism of electrically lighted locomotives will be given in next month's issue of The Canadian Engineer, with a diagram showing the independent and complete equipment, each locomotive having its own separate and distinct steam engine, a rotary, and dynamo for generating the light. All of the lights can at the will of the engineer, by suitable switches, be turned on together or individually as may be desired.

IMPROVE THE WHITE SPACE YOU BUY.

The paper can only sell you so much white paper, as a real estate man would sell or lease you so much vacant property, it remains for you to improve it and make it pay.—Ex.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Waterloo C. A. S. E., No. 17 elected the following officers for the ensuing year at the annual meeting held July 20th: Pres., J. L. Wendle; vice-pres., G. Beam; sec.-treas., F. A. Pflug; conductor, J. Gross; doorkeeper, J. Uttley; delegate to convention, J. Uttley.

LACHINE RAPIDS HYDRAULIC AND LAND CO.'S FIRE EQUIPMENT.

On the 26th ult. a test was made of the new fire apparatus installed at the power house of the above company at Lachine Rapids. The test was witnessed by a number of insurance men, engineers and aldermen, and was very satisfactory. The equipment consists of two sets of triplex pumps of a capacity of 1,000,000 gallons at a working pressure of 150 lbs. Each set is provided with a hot water priming tank as a protection against frost in winter, and the machinery is set on concrete foundations and surrounded by brick walls so that the pumps may work in spite of flames in other parts of the building. The pumps are double-chambered and have double suction pipes so that they can be worked from either direction in case one flume is empty. The pumps are operated by electric power, being connected direct to the main shaft by an electric clutch. The two sets of pumps serve twelve lines of hose, of which eight are inside and four on the roof, which is reached by stand pipes leading to towers on the roof, at equal distances from each other. In about 30 seconds from the first alarm streams were playing inside and outside the building. Adolphe Davis, C.E., complimented the company on the efficiency of its protection. During the remarks of other speakers the Montreal city council came in for criticism for its shameful neglect to provide proper inspection of electric wiring, which was promised as a part of the new building bylaws. After entertaining the visitors to refreshments Mr. Walbank made a short speech referring to the fire apparatus and the need of a better standard of work in wiring houses. Ex-Mayor R. Wilson Smith, on behalf of the directors, said he thought the company was entitled to credit for having given the city these great works with local capital entirely. In the progress of the work, whenever more money was required, they had enough faith in the enterprise to put their hands in their own pockets, and never came to the banks for a cent of credit.

HOT WATER HEATING.

Editor CANADIAN ENGINEER :

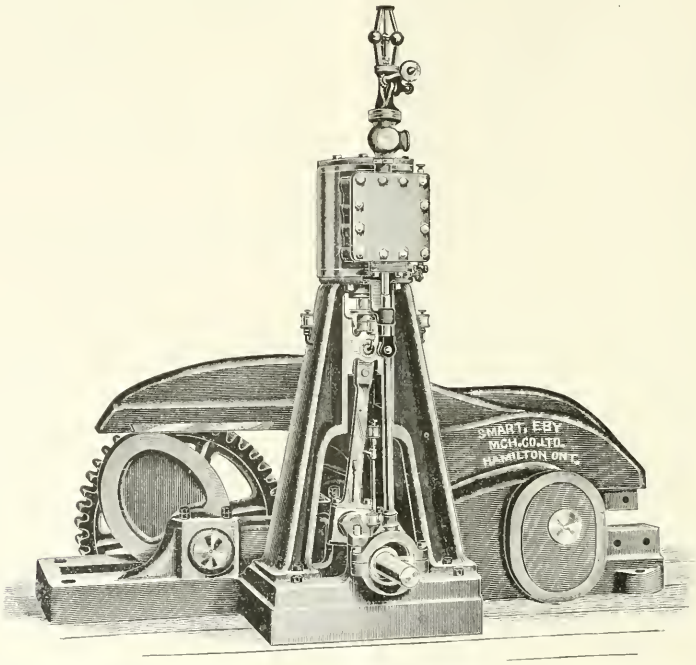
SIR,—Kindly inform me as to the probable cost of heating an eight-roomed house, containing about 10,000 cubic feet. One inch iron pipe will be used for radiators and coal as fuel.

Durham, Ont., July 24th, 1900. C. G.

[We presume hot water is the means of heating desired though not mentioned. The coal necessary will be from five to ten tons depending on the thickness of the walls, the tightness of windows, etc., and whether double windows are used or not. Important factors are also the situation of the house with regard to prevailing winds, the number of the family and their habits as to leaving bedroom windows open at night, etc. It is safe to assume, however, that a well planned and fitted hot water apparatus will burn half the coal that the stoves necessary to produce the same heat would require. Hot air will burn about two-thirds of the coal required by the stoves.—Ed.]

ALLIGATOR SHEARS.

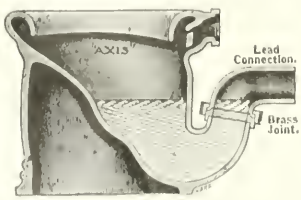
The Alligator shears which the Smart-Eby Machine Co., Ltd., recently built for the Hamilton Steel and Iron Co., are specially designed for their work, and are used for cutting bars and small billets to the lengths before bundling, preparatory to re-rolling. The engine is built especially strong so as to withstand the jar of this class of work. As the men run on piece work the engine is fitted with a throttling governor so that the



speed may be readily adjusted, thus allowing a larger output when cutting small bars. The engine being vertical takes up less room than if it were horizontal, at the same time reducing the friction to a minimum. The gear and pinion are extremely heavy, the pinion being shrouded. As shown by the cut there is a steel shoe upon which the cam wears while operating the shear, this steel piece is readily removed when renewing as may be required. There is also a heavy wrought iron band shrunk on the bed casting at the shoes to prevent any possibility of it splitting under heavy strains.

CLOSET BASIN EASILY CONNECTED.

In last month's issue we omitted the illustration from a paragraph in Improvements in Private Draining, in which we spoke of an article showing how plumbing fixtures might be connected above the floors, published some time ago. At that time there appeared to be no closet basin made that could be easily connected in that way, but we sent copies of the article



to manufacturers, and now there is a basin on the market that is the very article required (as shown in the illustration), because it is a P trap with a brass bend attached, which is coupled to the closet with a union joint enabling the end of the bend to point in any direction towards the soil pipe branch in whatever position the vertical soil pipe might be placed.

ACCIDENTS OF THE MONTH.

Wm. Powley, G. T. R. fireman, Niagara Falls, Ont., placed his hand on the rheostat in the Canadian branch works of the Carborundum Co., and was instantly killed.——At Cache Bay, on Lake Nipissing, the boiler in the sawmill of G. & J. W. Gordon, Pembroke, Ont., blew up killing the fireman, A. Quinn. The boiler was thrown 200 yards.——A fly-wheel in Sutherland & Innes Co.'s stave mill, Alvinston, Ont., burst, seriously injuring D. McLeod, Chatham, Ont., and five others.——The schooner "Picton" foundered in Lake Ontario, and Capt. Sidley, his son, three sailors and a cook were drowned.——L. Dufresne and P. Terrion, miners employed in the Belmont, Ont., gold mines, were instantly killed by the premature explosion of a blast.——A boiler blew up at the Adams Wagon Works, Paris, Ont.; A. Stapleton of Jerseyville, was wounded. The portable engine, which was driving a circular saw, was wrecked; the two front wheels, axle and tongue of the truck upon which the engine stood were thrown over a neighboring house.——While working at the Canada Foundry, Toronto, C. McGuinn fell into a vat of boiling clay wash, receiving fatal injuries. A short time ago a man named Higgins fell into the same vat, and died from his burns.

FIRES OF THE MONTH.

July 5th. W. S. Loggie Co.'s canning factory at Kouchibouguac Beach, N.B.; loss, $2,000.——July 11th. Jas. A. Spence's electric light plant, Colborne, Ont.; loss, $7,000; no insurance.——July 15th. S. Donaldson's flour mill, Donaldson's Mills, Ont., on the Kingston & Pembroke Ry.; loss, $2,000.

July 17th. Cheese and butter factory at Loretto, Man.——July 18th. Bready, Love & Tyron's elevator at Killarney, Man., was destroyed by fire, and Doyell & Co.'s elevator. The losses were fully covered by insurance.——July 25th. McDonald Bros.' electrical supplies premises, Winnipeg; loss, $9,000.——Sawmills at Kemptville, N.S., burned, with lumber; loss, $24,000.

The steel steamer "Sir William Siemens," arrived recently at Fort William with the largest load of coal brought into the harbor, 5,556 tons, and drawing 17 feet of water. The largest load of coal brought in previously was by the "Aurania," which carried 5,000 tons from Cleveland.

MINERAL OUTPUT OF BRITISH COLUMBIA.

The report of the Commissioner of Mines for the Province of British Columbia for 1899 shows that the yield of the mines in that year was worth $12,356,555, as against $10,906,861 in 1898. To this increase of almost a million and a half every mineral contributed save two. Silver, which in 1897 headed the list, shows a shrinkage from the figures of 1898, and the baser metal, lead, which is found chiefly in silver ore, has likewise fallen off. The value of the production for the last three years is shown in the following table:

	1897.	1898.	1899.
Gold, placer	$ 513,520	$ 643,346	$ 1,344,900
Gold, lode	2,122,820	2,201,217	2,857,573
Silver	3,272,836	2,375,841	1,663,708
Copper	266,258	874,781	1,351,453
Lead	1,300,517	1,077,581	878,870
Coal	2,648,562	3,407,595	3,882,396
Coke	89,155	175,000	171,255
Other materials	151,600	151,500	206,400
Totals	$10,455,268	$10,906,861	$12,356,555

The tremendous leap in placer gold, from $643,346 to $1,344,900, is due to two causes—one, the addition of Atlin's output, amounting to $800,000; the other, a plentiful supply of water for hydraulic operations in Cariboo and Cassiar. In lode gold the returns show great progress, the value of the output being $2,857,573, as against $2,201,217 in 1898. This increase of $656,356 is credited to the increased tonnage of the Rossland camp, and to the operations of the Ymir mines.

Industrial Notes.

Canadian capital will, it is said, build a $75,000 summer hotel at Sydney, C.B.

A pulp mill is to be established at a point up the coast from Vancouver, B.C., by L. F. McKenzie.

A. & R. Loggie, Loggieville, N.B., are building a canning factory 150 x 40 ft., at Inkerman, Gloucester county, N.B.

Plans have been prepared for a new hospital in Barrie, Ont., to cost $12,000. W. Sarjeant is secretary of the board.

A New Glasgow, N.S., firm is building a sawmill at George's Pond, Nfld., to have a capacity of 1,000,000 feet of lumber a year.

An Ottawa industry, the McKay Milling Co., may leave Ottawa and locate in Prescott, Ont., which has received a very advantageous offer from that town.

The Buntin Co.'s paper mill at Valleyfield, Que., has been sold to the Montreal Cotton Co., which will use it in the present enlargement of its mills.

Glace Bay, Reserve mines and Bridgeport, C.B., combined have a population of 20,000, with an assessed value of $850,000. It is proposed to make a city of the three towns, and connect them by a tramway.

A new swing bridge is building at Kemptville, Ont. E. T. Wilkie, Carleton Place, Ont., is the engineer. The masonry contract has been given to Geo. Bradford, Almonte, Ont., and the superstructure to the Hamilton Bridge Works.

The Bank of Nova Scotia is building a new office building in Sussex, N.B. Plans have also been prepared for buildings in St. John, N.B., and Charlottetown, P.E.I. Bond & Smith, Toronto, architects to the Bank of Nova Scotia, have the work in hand.

The Galt, Ont., town council has appealed to the Attorney-General to prevent the removal of the Robertson-Taylor Co. from that town to Guelph, Ont., because Guelph has offered a bonus of a piece of land valued at $1,500, which is to be sold to the company for $250, this being an illegal act.

The Kingston, Ont., locomotive works were put up at auction July 10th. J. W. Pyke, Montreal, offered $30,000, and John McElvey, Kingston, $50,000. There was a reserve bid, said to be $120,000, and there was no sale. The work on hand will keep the plant running till the end of September.

A large pulp mill is said to be a probability at Arnprior, Ont.

Muller & Co., Toronto, are building a $5,000 box factory, Esplanade and George streets, Toronto.

The contract for the Meaford, Ont., harbor improvements has been let to M. A. Piggott, Hamilton.

The machinery is on the ground ready to be placed in the Berlin, Ont., Furniture Co.'s new factory.

Petrolia is to have a pork-packing factory with a capital of $100,000, of which $25,000 has been subscribed.

Douglas Bros., contractors, New Glasgow, N.S., have opened a branch of their business at Sydney, C.B.

The Dominion Paving Co., Toronto, will put up a small sawmill at Lindsay, Ont., to cut paving blocks.

The various ironmoulders' shops in Ottawa, Ont., have signed an agreement for a 10 per cent. increase for one year.

The Sisters of Providence will build a large school on the block between Ontario, Aylwin and Cuvillier streets, Montreal.

R. Brown & Sons, manufacturers of ploughs, etc., New Glasgow, N.S., have been succeeded by the Brown Machine Co.

Brown & Rutherford's new planing mill on Point Douglas, Winnipeg, replacing the one burned, is completed and work resumed.

Sir William Macdonald will build and endow a crematory upon the most approved plans in connection with the Mount Royal cemetery, Montreal.

A joint stock company is being formed under the name of the Lanark County Peat Fuel Co., for the purpose of manufacturing peat for fuel purposes.

Brockville, Ont., will have a new hotel built by T. Tompkins, to have a frontage of 80 feet on King street and 150 feet on Home street. It will cost $50,000.

The statement recently made in the press that Wood, Vallance & Co., Hamilton, Ont., would go into the manufacture of bent wood in Belleville, Ont., is incorrect.

The Department of Public Works, Ottawa, has completed plans for the new bridges over the Chaudiere slide, Ottawa, to cost $19,500.

W. J. McNally, Ottawa, Ont., is organizing a company to build a butter factory at Almonte, Ont. Creameries are also proposed at Pembroke, Ont., and North Bay, Ont., by different companies.

T. A. Trenholme, J. N. Greenshields, W. T. Trenholme and B. Shepherd, Montreal, are being incorporated as the Guaranteed Pure Milk Co.; capital stock, $30,000; chief place of business, Montreal.

E. H. Barchard, W. F. Robinson, L. Macfarlane, A. R. Holden, and E. Vipond, Montreal, are being incorporated as the Canada Cold Storage Co., Ltd.; capital stock, $1,000,000; chief place of business, Montreal.

The Nut Oil Refining Co., Toronto, are buying a factory north of St. Clair avenue, Toronto, known as the hat factory, where it will make condensed milk, cocoa butter, cocoanutine, cheese and similar commodities.

Carnegie, Jones and Laughlin and the Federal Steel Trust have, it is reported combined to crush the small producers of the iron and steel market. Steel billets, which sold last winter at $56 a ton, can now be quoted at $17.

The Canada Cycle & Motor Company, the National Cycle Co. and the Canadian Motors, Ltd., have supplied their various types of vehicles to the post office in Toronto recently, for a series of tests in rapid mail delivery to branch postoffices.

Holbrook & Sutherland have the contract to build the new paper and finishing mill for the E. B. Eddy Co., to be three stories, 50 by 100 ft. and completed September 15th. One thousand men are now employed on rebuilding this company's works.

On July 18th, St. Catharines, Ont., voted a bonus of $4,000 a year for fifteen years to the Welland Vale Mnfg. Co., and fixed the assessment of the Kinleith paper mills at $22,000 for ten years. The bylaw to raise $25,000 for a new collegiate institute was thrown out. The Welland-Vale Co.'s axe and tool factories, burned down some months ago, will be at once rebuilt.

St. Henri, a suburb of Montreal, will appoint a boiler inspector.

The Maritime clay works, at Pugwash, N.S., have recently placed a lot of new machinery in position.

Through the generosity of Mrs. Peter Redpath, the Redpath library, McGill University, Montreal, will be enlarged.

A new brick-making machine has been installed in the Avonport, N.S., Brick Co., and it now turns out 30,000 bricks per day.

Ottawa will use thirty million bricks this season, of which nearly five million will come from the Empire Brick Works, St. Jean des Chaillon.

One hundred and twenty-five delegates attended the convention of the Glass Bottle Blowers' Association of the United States and Canada, in Detroit, last month.

The heating and ventilating committee of the Toronto School Board have decided to recommend an experiment with steam heating and fan ventilation in one school.

A company is being formed in St. Johns, Que., to make emery wheels. This will be an extension of a business that has been carried on in a small way for some time.

The Stewart-Arbuthnot Machinery Co., Winnipeg, is supplying the machinery for a sawmill at Coal Creek, near Fernie, B.C., for A. D. McRae. Capacity, 40,000 ft. per day.

S. Getty, J. Getty, S. McKeown, J. Campbell, E. J. Cudmore, H. C. Brown, Aaron W. Tanner, and A. S. Hurlburt, are being incorporated as the Farmers' Elevator Co., of Caron, N.W.T. The capital stock is $7,500.

Joseph Howard, Howard's Station, Newfoundland, is organizing a company to be called the St. George's Lumber Co., to operate 50 square miles of timber lands on the line of the Newfoundland Railway. He is building a large steam sawmill.

Wm. Murdock, C.E., waterworks engineer, St. John, N.B., is preparing plans for an extension of the water supply system to Loch Lomond. The cost of building will be in the neighborhood of $250,000, exclusive of land damages or water rights.

The Hon. T. Berthiaume, H. Lamontagne, F. Lapointe, R. L. de Martigny, E. Lepage, J. U. Foucher, Montreal; L Bolduc, and A. Guimond, St. Louis, are being incorporated as the Montreal Automobile Co., Ltd.; chief place of business, Montreal; capital stock, $250,000.

Recently the Robb Engineering Co., Ltd., Amherst, N.S., has installed a hydraulic riveting plant, pneumatic chipping and caulking tools, and other labor and time-saving machinery, which enable this firm to compete in any market in the world, as shown by its frequent foreign shipments.

The Ontario Government gives free farms to settlers in Western Ontario, and has arrangements with the railways by which intending settlers are carried from Port Arthur to Dryden, Wabigoon, etc., at one cent a mile. Large numbers are moving in, and the lands are very fertile.

The employees of the Dominion Iron & Steel Co.'s machine shops, Sydney, C.B., collected a considerable sum, which they have devoted to buying two very large flags, which were hoisted with much cheering and whistle blowing. They were a Union Jack and a Canadian ensign.

The Toronto Pressed Brick and Terra Cotta Co., Ltd., is in difficulties. F. J. D. Smith, with a mortgage claim of $35,031 against the company's property in Milton, Ont., has taken possession, and put in a manager of his own. He has now issued a writ to obtain an absolute title to the property.

Incorporation has been granted to C. S. Grosch, F. G. Rumball, W. J. Stinson, A. Robinson, and W Gray, London, Ont; E D Lang, Hon. S. Merner, Berlin, Ont., as the Acetylene Manufacturing Co., of London, Ltd., to make and deal in acetylene gas apparatus and fixtures; head office, London, Ont; capital stock, $5,000.

It is reported from Grand Forks, B.C., that J. P. Graves, manager of the Granby smelter, offers to buy the city's water works and electric light plants, with a franchise, for twenty five years. He agrees to pay the city $70,000, besides spending $30,000 in improvements to both systems. He also wants street railway privileges for the same time. He also offers the town of Columbia waterworks, electric lights, and a trolley line for that city, if he gives a bonus of $30,000.

The Canadian rights of the "gas Riche," described in another part of this issue, are for sale. Mr. Neil, the chemist and expert of the company, is now in Montreal at the address named in the advertisement.

Debentures are to be issued by Nelson, B.C., for $15,000 for extending the waterworks system, $15,000 for extending the electric light system, $20,000 for the sewer system, $20,000 for street improvements, and $6,000 for a road-making plant.

The contract for building pier No. 2, and other improvements in the Montreal harbor has been awarded to Malone Bros., Three Rivers, Que. Among those who tendered were Davis Bros., Ottawa; Connolly Bros., Larkin & Sangster, St. Catharines; Pigott & Ingles, Hamilton, and R. Macdonald, C.E., Toronto. A deposit cheque of $50,000 was required. A new provision in the contract is that only fifty per cent. on work done will be paid until the whole contract is completed.

W. T. Jennings, C.E., and J. R. Roy, C.E., the engineers appointed by Toronto and the Dominion Government to report upon the improvements for Toronto harbor reported in favor of work costing $1,194,787 for all the dredging and cribwork required, as follows: Dredging harbor, $140,000; eastern entrance, $256,000; western entrance, $21,000; Ashbridge and Don channel improvement, $100,000; Don works, $80,000; placing groynes, $150,000; making areas of land, Block A, $135,000; Block B, $107,000; Block C, $85,500; Block D, $120,287.

The iron moulders' union and the Montreal iron founders have agreed on a rate of wages of $2.15 per day, till May 1st, next. The agreement was signed July 13th, by the Lamie Engine Co., John McDougall, Moses Parker, Garth & Co., Canada Switch & Spring Co., H. R. Ives & Co., P. Amesse, Wm. Rodden & Co., Montreal Pipe Foundry Co., Warden, King & Son; the agreement is signed on behalf of the Iron Moulders' Union, No. 21, by A. R. Mitchell; on behalf of the Iron Moulders' Union of North America, by D. Black, chairman; and on behalf of the National Founders' Association by J. M. Taylor, chairman.

St. Louis, a suburb of Montreal, has prepared a by-law to authorize the council to buy the plant of the Water & Power Co., consisting of mains, etc., for $135,500, and to issue debentures for the amount, redeemable in forty years. It is a condition that the Water & Power Company shall supply the water to the town for a term of forty years at the following rates per one thousand gallons: For the first five years, fifteen cents; for the next ten years, twelve and one-half cents; and for the last twenty-five years, ten cents. The company reserves the right to lay mains through the streets to connect its western reservoir with consumers beyond the eastern limits of the town.

Judge Pagnuelo rendered judgment recently in the Consolidated Car Heating Co. v. F. E. Came. The company, plaintiff, as assignee of a patent obtained at Ottawa on the fourth day of May, 1887, by J. H. Sewall, inventor, for an improvement in steam hose couplings, complained of infringement by the defendant, who is in Canada the agent for the Gold Car Heating Company, and prayed for an injunction and damages. For over eighteen months, according to the plaintiff, the defendant has imported and sold in Canada, the steam hose couplings known as the "Gold hose couplings," and the "Gold straight port steam couplings," which contain in substance Sewall's invention. The defendant filed: 1. Sewall's patent was anticipated and not patentable. 2. It has not been infringed by the Gold coupler. 3. Importation of the patented article, and forfeiture of the patent. 4. Sewall abandoned his invention to the public prior to obtaining his Canadian patent. The court rejected the defendants pleas, held that the defendant had infringed upon Sewall's patent, and granted plaintiff's prayer for an injunction and damages, which, by consent, had been limited to $25, up to the date of the suit, and for costs of the highest class.

The new pulp mill near Danville, Que., recently bonused to the extent of $10,000 by that village, is progressing well. The building is almost finished and the dam will be erected as soon as the river subsides. James Morrill, the principal proprietor, expects to have the works completed by the end of the

year. The mill is to produce ground pulp, and will have a capacity of 25 tons per day.

The Newfoundland correspondent of The Montreal Gazette, referring to the formation of the Reid Railway Lands Company, Ltd., says: A short time ago The Reid Steamship Company, Ltd., was formed, to which was transferred Mr. Reid's fleet of eight steamers, including the "Bruce." Seven of these steamers are employd on the Bay and Labrador service. This company, with a capital of $4,000,000, acquires all the lands conceded to Mr. Reid under the contract, including the Benton sawmills—in all about four million acres, in fee simple, with all their timber, minerals, cultivable lands and water privileges. It may erect pulp mills and develop mineral lands. This is the second of the series of companies, now in course of formation, which will acquire the various franchises held by Mr. Reid under his contract. They are part of a larger plan to transfer the railway contract to one great company, having power to acquire the various smaller companies now being formed. The transfer of the railway contract requires the sanction of the Government, which is at present refused. These companies meantime, possessing the various properties, can turn them to account, leasing the lands and working the minerals and forests, pending the railway contract transfer, which may come about in the future, and wanting which the new land company could not develop their properties on the large scale which is ultimately aimed at. The telegraph lines and the dry dock will probably be placed under the charge of similar companies, as they are among the Reid franchises.

—The man who looks ater a little advertising space carefully will soon find that he can afford a larger one.

—Prof. C. H. Benjamin, Cassier's Magazine, asks that fly wheels be inspected with as much care as boilers, because the high speeds now customary makes them even more dangerous, if defective.

Electric Flashes.

Springhill, N.S., is trying to install a municipal lighting plant.

The Inverness & Victoria Telephone Co. is running a line to Sydney, C.B.

A most daring robbery of miles of copper wire, the property of the Edison Co., at Detroit, took place last month.

The Colborne, Ont., electric plant, owned by J. A. Spence, was burned out, July 11th. The loss was about $7,000; no insurance.

The Cataract Power Co. is installing two additional generators, and will deliver in Hamilton, Ont., 10,000-h.p. next month.

Glen Tay, Ont., is spoken of as the location of a carbide industry from Ottawa. A considerable water power is now going to waste.

The Montreal Street Ry. Co. has made an agreement with the Chambly Manufacturing Co. for 5,000-h.p. for 23 years, at the rate of $25 per h.p. per annum.

Brockville, Ont., has voted $100,000 to buy out the existing light and power company and instal a municipal plant. It will be managed by a commission of five.

J. S. Shantz, Hespeler, Ont., has sold his electric plant, without boiler or engine, to the town, and $10,000 has been voted by the ratepayers to develop the system.

The Farmers Co-operative Packing Co., Ltd., Brantford, Ont., has bought from the Royal Electric Co., Montreal, a direct current plant to light its packing houses at Brantford.

The first new 2,000-k.w. generator for the cataract power company of Hamilton, was shipped from the shops of the Royal Electric Co., Montreal, on the 25th inst. It occupied four cars.

C. W. Thompson of the Napanee Mills Paper Co., Newburg, Ont., is replacing his arc lighting plant with a complete direct current incandescent system supplied by the Royal Electric Company.

A new professor in mechanical and electrical engineering is to be appointed at the Kingston, Ont., School of Mines, who will also take the same work in civil engineering.

The Citizens' Electric Co., Ltd., Smith's Falls, Ont., has been incorporated, with $35,000 capital. J. H. Gould is president, and J. S. Gould, secretary, and is enlarging its plant.

The Volta Electric Storage Co., Ltd., of Hamilton, is installing a battery switchboard for W. E. H. Massey, at his farm at East Toronto. This switchboard is being built by the Royal Electric Co.

The Cataract Power Co., Hamilton, Ont., has a contract to light the Hamilton Asylum for the Insane, with 1,100 incandescent and ten arc lamps for $2,750 a year. This is a saving of $900 a year over gas.

The West Lorne Electric Light Co., West Lorne, Ont., has been incorporated with a capital stock of $2,000. The provisional directors are J. A. McKillop, D. McPherson and Thomas Wrong, all of West Lorne.

The Almonte, Ont., Electric Light Co. has offered to light the town for $60 per lamp per year. A municipal plant is under discussion, for which it is proposed to utilize the large power now idle at Blakeney, three and one-half miles distant.

The Galt, Ont., Gas Light Co., has ordered from the Royal Electric Co. a 100-k.w. S.K.C. generator with switchboard and exciter. Also a new switchboard for its present single-phase alternator, and one for the arc lighting system.

The electric power plant to be erected by the Lac du Bonnet Co., at Spirit Falls, Man., will develop 1950 horse-power. The power house, which will be 317 by 50 feet, will be brick and stone. Power will be conveyed to Winnipeg, 62 miles distant.

J. A. E. McCabe, J. A. Begin, E. A. McCone, L. Duchesneau, M. Bourassa, Windsor Mills, Que., and H. A. Meagher, M.D., Montreal, have been incorporated as the Windsor Electric Company; capital stock, $24,000; headquarters, Windsor Mills, Que.

A. Barnet, P. S. Stewart, W. A. MacKay, and S. H. Murphy, M.D.; Renfrew, Ont., and J. Ferguson, Admaston, Renfrew County, Ont., have been incorporated as the Renfrew Power Co., Ltd.; capital stock, $50,000; chief place of business, Renfrew, Ont.

The Volta Electric Storage Co., Hamilton, Ont., is installing a 120-k.w. 110 volt, bipolar direct current generator, and a 25-k.w. direct current 250 volt multipolar generator for charging batteries and for testing purposes, bought from the Royal Electric Co.

The Dominion Government has ordered from the Royal Electric Co., Montreal, a 30-k.w. direct current multipolar generator, direct connected to a Robb-Armstrong engine, together with a marble switchboard, and arc and incandescent lamps to light the docks at Sorel, Que.

The Jones & Moore Electric Co. has shipped a new 20-h.p. motor to Morin & Ouelette, Hull, Que. The Ottawa Citizen has placed an order with the Jones & Moore Electric Co. for an electric motor to operate its new press. J. J. Howden, of Peterborough, has installed one of this company's new type motors.

The first sod on the Hamilton & Lake Erie power canal was turned with appropriate ceremonies at Silverdale, Ont., July 18th. The plan of the works filed with the Government when the company was incorporated, shows a canal starting at Welland River and running six and one-half miles to the Jordan River, where it runs six miles to Jordan village. A diversion canal will be built by which a fall of 255 feet will be secured.

J. B. Charleson, who is building the Canadian telegraph line from Dawson, reports that the line from the Vancouver end is completed to Hazelton by way of Ashcroft, and the line from Atlin, in the Yukon, is completed to Telegraph Creek, and that there are now but 500 miles of line to complete between the extreme points, which will be done in six weeks. Mr. Charleson has information from the United States War Department, stating that a cable is to be built by them from Nome to St. Michael's, and a line from St. Michael's to Fort Cudahy, on the border, to connect with the Canadian branch line from Dawson.

There is a plan under discussion for building an electric railway, connecting Three Rivers, Que., with Grand Mere, Shawinigan, St. Barnabe, St. Severe, Louisville and Yamachiche. The principal promoters are Mayor Paquin and P. E. Panneton. The North Shore Power Co., will supply power from the Batiscan River, 15 miles from Three Rivers, where 5,000 h.p. is available. Construction will begin in September.

J. J. Gartshore, dealer in railway supplies, Toronto, has recently shipped 300 tons steel rails to the Niagara, St. Catharines and Toronto Ry. for their extension to Niagara Falls, and is shipping a further quantity of about 475 tons for extension to Port Dalhousie; also 300 tons for the extension of an electric railway from Berlin to Preston, Ont.; and 250 tons for the Thames Valley electric railway between Woodstock and Ingersoll, Ont.

St. Mary's, Ont., has retained J. Parke, consulting engineer, Toronto, to furnish plans for an arc and incandescent municipal lighting plant. It has for some time past operated and owned its arc lighting system, and has recently bought the incandescent lighting plant from Reesor & Co. It is the present intention to combine the two plants into one system, and a new power station will be built, and a steam plant bought.

The estimated cost of buildings and machinery for a municipal electric power plant for Toronto has been prepared by the city engineer. It is $950,000. The cost of installing an arc lighting plant would be $300,000 for 1,350 lamps, using overhead circuits; or $510,000 using underground wires; the cost of operating, including interest and depreciation, would be $63 per lamp per annum, or 17.2 cents per night, with overhead circuits, or $70 per annum, or 19.16 cents per lamp per night with underground wires.

Writs are plentiful among those interested in the Hoepfner Refining Co., Hamilton, Ont. Besides issuing a writ against the company for breach of contract and the appointment of a receiver, Dr. Hoepfner has sued H. A. Frasch and Wm. Koehler to restrain them from participating in any business other than that of the Hoepfner Company. By way of retaliation the company has sued Dr. Hoepfner to set aside the agreements he made with the company, and for an order cancelling his stock in the company.

The Electrical Construction Co., of London, Ltd., has received an order from the Blind River, Ont., Lumber Co., for a 150-light multipolar dynamo for its mills and complete wiring of the mills and lumber docks; from the Central Peat Co., Welland, Ont., an order for one 25 h.p. multipolar generator, one 15 h.p., one 10 h.p., and one 5-h.p. multipolar motor to operate its works at Welland, Ont.; and a further order from the Stuart Arbuthnot Machinery Co. for one 16 h.p. and one 15-h.p. multipolar motor, and one 8-h.p. bipolar motor; by the McLean Publishing Co. Toronto, Ont., an order for a slow speed press motor to be direct belted to printing press; from G. E. Matthews, Montreal, for one 6-h.p. motor; Clark, Pennock & Co., London, Ont., one 8-h.p. bipolar motor; Malloch & Co., London, Ont., three 6 h.p. elevator motors; and Burnett & Sons, London, Ont., one 8-h.p. hoisting motor with controller; from the Mail Job Printing Co., Toronto, Ont., an order for six slow speed press motors. This order together with the three recently placed for the same purpose with the Salvation Army, Toronto, and two with the W. J. Gage Co., Toronto, shows the general favor with which these special slow speed motors are regarded.

The generalship shown by R. S. Kelsch, superintendent of the Lachine Rapids Hydraulic and Land Co.'s works, at the late fire in the company's Montreal sub station, has brought him many congratulations. Mr. Kelsch was just retiring at his home in Westmount when the lights in his house went down in a most unusual manner. Failing to get a response to a telephone enquiry he jumped into his clothes, and bolted down stairs. As he was disappearing his wife aimed an overcoat after him, and this bit of presence of mind saved him from serious if not fatal, injuries at the fire. Once in the street his initial difficulty was a cab. The first cabman he hailed said he was "waiting for a party inside." On Mr. Kelsch suggesting that this trip would be worth $2, the cabbie's whip cracked like a rifle, the vehicle wheeled about and in two seconds he was spinning to the scene of trouble. On arriving at the station the place was lit up by such a flash of electricity as has never been seen in Montreal, and the danger of the situation was revealed in that flash. While the firemen refused to play on the building for fear of getting a charge through the streams of water, Mr. Kelsch entered the building, went upstairs through the dense smoke—which was rendered more than usually stifling by the fumes of burning rubber—and creeping along the floor of the upper flat to avoid the denser smoke, got into the office and, managed to telephone a message to turn off the power. This done, the work of the brigade proceeded. Before the firemen were out of the building Mr. Kelsch had men at work on repairs. Electric heaters were started at drying the switchboards and apparatus—such of it as was not destroyed—and within 23 hours all the many items that had to be purchased and installed were in place, and the station in full operation.

Mining Matters.

The smelter at Northport, which handles Rossland ores is being doubled in capacity.

A very rich iron sand has been discovered on the Labrador coast. The analysis is said to show 68 per cent. iron.

The Knob Hill Mine Co., Rossland, B.C., has bought four 3¼ Little Giant drills from the Canadian Rand Drill Co.

A 20-h.p. hoist was a short time ago sold by the Jenckes Machine Co. to the Evening Star mine, Rossland, B.C.

A prospector named Wilson, of Perth, Ont., has discovered a large deposit of iron ore near Crow Lake, North Frontenac.

Hon. Peter McLaren, Perth, Ont., who bought the Diamond mine, Hastings county, Ont., from D. E. K. Stewart, has put in a 10-stamp mill.

More attention is being paid to the copper bearing ores of Texada Island, and considerable progress is being made in developing the Van Anda mines.

The position of Dominion Census Commissioner has been offered to Archibald Blue, director of the Ontaria Bureau of Mines, and it is understood he will accept.

The steamer "Themo," of the Algoma Central Steamship Co., arrived at Midland, Ont., recently with 1,940 tons of iron ore from the Helen mines, Michipicoten.

A gold brick, weighing 7,897 oz., valued at $135,275, the result of 62 days washing at the Consolidated Cariboo Hydraulic mine, B.C., was sent to the mint last month.

The Jenckes Machine Co. has sold to the British Columbia Copper Co., which is operating the Mother Lode, a 24 by 42 hoist, 200-h.p.; two 80-h.p. boilers, cages, etc.

At Moose River, N.S., recently, R. Kaulbach has uncovered what is considered to be a valuable gold bearing lead on the areas of the Colonial Mining Co. It is reported to run an oz. to the ton.

The chlorination plant of the Brookfield, N.S., Mining Co., is so successful under W. L. Liffey's management that concentrates from other mines formerly sent to New York now come to Brookfield.

The Pembroke Observer remarks recently on some specimens of platinum bearing ore from the property of F. A. Maloney, Calumet Island, which is near Gower Point, Westmeath, Renfrew county, Ont.

R. McL. Hunter, Duluth, U.S.; P. McKellar and D. McKellar, Fort William, Ont.; F. H. Keefer and A. W. Daby, Port Arthur, Ont., have been incorporated as Antikokan Iron Co., Ltd.; capital stock, $1,000,000; head office, Fort William.

Reports have come down from the Klondike of the finds of veins of conglomerate of vast extent and richness. Judge Dugas, who has just come down is reported to have said that there are thousands of miles of this conglomerate. The belts are of a very large extent. The conglomerate runs in a layer of about a foot and a half thick, and below there is gold bearing gravel which gives as good returns as the majority of placer properties. Assays made in Dawson give values of $8 to $28 for the conglomerate.

J. D. McDonald, a Sudbury, Ont., mining man, claims to have discovered a new process, combining the roasting and smelting of nickel-copper ores in one operation, with less than one-half the fuel and in eight to twelve hours. He is building a 50-ton experimental plant at one of the Worthington mines.

Dr. A. P. Coleman, geologist in the Ontario Government, has gone to the Paris Exhibition, where he will take part in the congress of geologists, which is a feature of the Exhibition. He will return to England and be present at the annual meeting of the British Association for the Advancement of Science. Dr. Coleman has two papers for this meeting, one of which deals with glacial drift phenomena in the vicinity of Toronto, and the other with the occurrences of jasper bands in Northern Ontario, as well as in the States of Michigan, Wisconsin and Minnesota. Dr. Coleman's work for the Ontario Bureau of Mines this year consisted in tracing out the jasper band, which is believed to extend across the country from Balchawana bay, on Lake Superior, to Temiscamingue, on the eastern side of the province. His section of the work lay from the boundary line between Algoma and Nipissing districts westward. He found jasper to occur in two parallel bands at a number of points, and the indications for iron ore associated with them are believed to be quite favorable. At one or two points there are breaks in the band, due to areas of Laurentian rocks, and in other places they are probably covered over by swamp land and drift. The locating of these jasper belts will no doubt prove of great convenience to prospectors, as by following them there is the likelihood of the discovery of iron ore deposits.

Nevil N. Evans, M.A.Sc. (McGill), who has successfully filled the post of lecturer in chemistry in McGill University for the last few years, has been promoted to the assistant professorship in the same subject. The staff in chemistry has also been strengthened by the appointment of James Henderson, M.Sc. (St. Andrew's), Ph.D. (Munich), as senior demonstrator; of Frederick Soddy, M.A. (Oxon.), A. Douglas McIntosh, B.A. (Dalhousie), Ph.D. (Harvard), and Charles F. Lindsay, B.Sc. (Dalhousie), Ph.D. (Johns-Hopkins), as demonstrators, and E. H. Archibald, B.Sc. (Dalhousie and Columbia), as lecture assistant. Dr. Henderson has already filled a demonstratorship in chemistry in McGill. It will be noticed that three of the appointees are Canadians, hailing from the Maritime provinces. Dr. McIntosh is a graduate of Dalhousie University, Halifax, where he did much excellent original research work. He graduated in 1896 with high honors in mathematics and mathematical physics. He subsequently took a post-graduate course at Cornell, where he received his M.A. degree in 1898. After a course of study in Germany he became an assistant at Harvard, whence he received his doctor's degree last year. Mr. Soddy is a graduate of Oxford University. He has for several years been connected with the teaching staff of that institution. Mr. Lindsay is a graduate of Dalhousie University, and a native of Pictou, N.S. During the past year he has taken a course at the Johns Hopkins University, Baltimore. The appointments will take effect at the opening of the autumn session in September. S. B. Allen, B.Sc., has been appointed demonstrator in civil engineering; E. Andrews, B.Sc., demonstrator in mining, and P. W. K. Robertson, B.Sc., Dawson fellow in metallurgy. These were all members of this year's graduating class in Applied Science.

The Algoma Central Co. is shipping its first cargoes of iron ore from its Helen mine, 125 miles north of Sault Ste. Marie, Ont. The Helen mine is an outcrop lying between characteristic rocks of the Lake Superior iron-bearing region. It is 12 miles from and 640 feet above the lake at Michipicoten Harbor, and the exposed portion of the deposit is about 400 feet wide and 700 feet long. In this distance it rises 120 feet. At the foot of the bluff, tunnels have been driven into the bluff 240 feet, reaching the counter rock. At the west end the ore body extends under the lake to its deepest point, 125 feet below water level. This lake can be drained by a short tunnel. The company estimates that it has 15,000,000 tons in sight by measurements and diamond drill borings, with 200 feet of ore below the lake level, and when borings were discontinued, the coves were still ore. The full extent of the deposit is therefore unknown. Its width of 400 feet does not include a strip nearly half as wide of a lower grade of soft hematite, economically valuable only when transportation costs are not great. The company expects to utilize this at its works at Sault Ste. Marie. The Helen mine, being an open quarry on a side hill, with an earth covering varying from nothing to a few feet, will be at first worked cheaply. The company has installed a No. 8 Gates' crusher, capable of breaking at least 5,000 tons per day, and will at once erect a duplicate plant. The crushers will be fed by Lidgerwood cableways from the mine faces. The company has received two 2200-ton English built ore skips and will install two more at once. It will build four more of 3,000 tons each next year. It is receiving a heavy equipment of locomotives and cars and dumped its first 50-ton cars into its dock July 14th.

Personal.

T. G. Williams, formerly foreman of the electrical department of the Montreal Street Railway, died a short time ago in Montreal.

W. Boyley, New York, has been engaged as teacher of the technical class to be established, with Government aid in the Collegiate Institute, Kingston, Ont.

J. C. McNeal, the late superintendent of the Hamilton Blast Furnace Co., was presented with a silver tea service on his leaving the employ of the company, by a number of the employees.,

Wm. Johnston, stationary engineer at the Royal Military College, Kingston, Ont., fell dead while attending the funeral of John Donnelley. He was a brother of Capt. G. Johnston, of the Richelieu & Ontario Navigation Company, Montreal.

W. L. M. King, B.A., LL.B., has been appointed editor of the Canada Labor Gazette, the publication of which is provided for in the Conciliation Act passed by the House of Commons at the last session. He has held fellowships in Toronto, Harvard and Chicago Universities.

Jas. Clarke, Brockville, Ont., who was employed on the first survey of the Grand Trunk Ry. west from Coteau, and was afterwards a conductor, and finally agent of the G. T. R. at Prescott and Brockville, was found dead in his bed, July 8th, in Brockville.

John W. Marr has resigned his position as engineer of the Bond Lake power house of the Metropolitan Railway Co., to go on the road for the Steam Specialty Co., of Toronto. Mr. Marr's successor at Bond Lake is Thomas Morgan, lately in charge of the Toronto Island lighting plant.

Raoul de B. Corriveau, B.Sc., who graduated with honors in Applied Science at McGill, son of A. J. Corriveau, of the Montreal Park and Island Ry., has been appointed on the engineering staff of the Dominion Public Works, and is now engaged on surveys in the Lower St. Lawrence.

Samuel King, master carbuilder at the G. T. R. shops in London, Ont., has resigned to take a responsible position on the Intercolonial Ry. at Moncton, N.B. Mr. King has been in the service of the Grand Trunk for about 25 years. He will be succeeded by Thomas Treleaven of East London, Ont.

John Dickson, a moulder at the James Stewart Mnfg. Co., Woodstock, Ont., had a narrow escape from death by lightning recently. He was standing in front of the cupola with a ladle, the handle of which is four or five feet long and of three-quarter inch round iron, in his hand, when a flash of lightning wrenched the ladle from his hands, bent it badly and threw him to the ground. He felt no serious inconvenience from his adventure however.

A. C. Wurtele, secretary-treasurer of the Atlantic and Lake Superior Railway, died suddenly recently from heart disease. The deceased was a brother of Judge Wurtele, and 63 years old. For some years Mr. Wurtele was connected with the business management of some of the French papers in Montreal. He was also secretary-treasurer of the Baie des Chaleurs Railway, and manager of l'Assomption Railway. Some few

months ago, before its collapse, he became a director of the Ville Marie Bank, but he disclaimed all responsibility in its management.

Wm. Hetherington died recently in Toronto. He was widely known in marine circles in Canada, having been a lake captain since a young man. He sailed the blockade runner "West Wind," which was at one time the fastest boat on the Upper Lakes. In his time he had commanded many of the large boats on the Upper Lakes. He leaves one son, Wm. T. Hetherington of the Great Northern Railway at Montreal, and one daughter. John Hetherington of the Grand Trunk Railway is Toronto is a brother of deceased.

A. H. Leake, L. H. Bennett and E. B. Kidner are the teachers employed by Prof. Robertson to establish schools for manual training in Canada as provided for in Sir Wm. C. Macdonald's generous gifts some time ago. Mr. Leake goes immediately to Brockville, where it has been definitely decided to open a summer course for teachers of Ontario. In the fall Mr. Leake will take charge there of the school for pupils, and at first confine his instruction to educational hand work. Mr. Kidner has gone to Truro, N.S., and after assisting in the explanation of the methods to teachers at Brockville, Mr. Bennett will take charge of the schools to be opened in three country districts in Quebec.

Railway Matters.

The Michigan Central has given $2,500 to the proposed new Y.M.C.A. building, St. Thomas, Ont.

The Great Northern Railway of Canada has taken over the short line between Lachute and St. Andrew's, Que., and will operate it.

R. R. Dobell has bought the C. P. R. elevator at Quebec and will use it in connection with his freight steamers and the Great Northern Railway of Canada.

As the solution of the jealousy between Sydney and North Sydney, C.B., in railway matters, a line is suggested from the Strait of Canso through St. Peters direct to Sydney.

The C.P.R. is calling for tenders for construction of masonry bridges at Cook's Creek, East Selkirk, abutments for 60 feet span; Strawberry Creek, Kaministiquia, 25 feet arch culvert; Fish Creek, three miles west of Maple Creek, abutments for 60 feet span; Pipestone Creek, Laggan, pier and abutments for two 66 feet spans; near Murray Park, southwestern branch, 25 feet arch culvert.

In the case of E. P. Hannaford vs. the Grand Trunk Railway Company it will be remembered that the plaintiff claimed $6,000 from the company, as salary for one year, his pretension being that he should have been given one year's notice of his dismissal as chief engineer of the company. The decision recently given held that one month's notice was sufficient, and the action was dismissed. This judgment will be taken to the Court of Appeal.

The Dominion Government at the session just closed voted the following railway subsidies: The Irondale, Bancroft and Ottawa Railway, from Minden, Ont., twelve miles, $38,400; Strathroy's Western Railway, from Canada, Ont., to Strathroy, Ont., seven miles, $22,400; Pembroke Southern Railway, towards a point on Irondale, Bancroft and Ottawa Railway, twenty miles, $64,000; Algoma Central Railway, extension, twenty five miles, $160,000; Central Ontario Railway Co., extension to point on Can. Atlantic Railway, twenty miles, $64,000. Manitoulin and North Shore Railway Co., from Little Current, sixty-six miles, railway from Bracebridge, in Muskoka, fifteen miles, $18,000; railway, twenty miles from Parry Sound to French River, thirty five miles, $112,000; railway, twenty miles, north east of Haliburton towards Mattawa, Ont., forty miles, $128,000; Kingston and Pembroke Railway Co., to iron mines in Bedford Township, Ont., twelve miles, $38,400; Thousand Islands Railway Co., extension to point easterly, two miles, $6,400; Thousand Islands Railway, extension to connect with Brockville, Westport, Sault Ste. Marie Railway, Bay of Quinte, Smith's Falls, and Ottawa Railway, nine and one half miles; railway from Dyment to New Klondike mining district, Ont., seven miles; Schomberg and Aurora Railway, extension to Bond's Lake, Ont., four miles, $12,800; Nipissing and James Bay Railway Co., from North Bay station towards James Bay, twenty miles, $64,000; Ottawa and New York Railway Co.'s bridge over St. Lawrence, and for Canadian portion of such bridge, $90,000; Grand Trunk Railway Co., of Canada, rebuilding and enlarging Victoria bridge over St. Lawrence river, P.Q., $230,000; railway and traffic bridge over Ottawa river, at Nepean Point, between Ottawa, Ont., and Hull, Que., $100,000; Canadian Northern Railway Co., extension north of Swan River towards Prince Albert, N.W.T., one hundred miles, $320,000; railway from point on Alberta Railway and Coal Co.'s Railway towards Cardston, Alberta, N.W.T., thirty miles, $75,000; Kaslo and Lardo-Duncan Railway Co., extension from Duncan Lake towards Lardo, thirty miles, $96,000; Restigouche and Western Railway Co., extension toward Campbellton, N.B., fifteen miles, $96,000; railway from St. Charles' Junction towards the St. Francis branch of the Temiscouta Railway, Quebec, forty-five miles, and from mouth of St. Francis river, N.B., towards St. Charles' Junction, fifteen miles, $192,000; railway from Bristol, Carleton County, N.B., on C.P.R., easterly, seventeen miles, $54,400; railway from Shediac, N.B., to Shemoque, towards Cape Tormentine, thirty-eight miles, $121,600; railway from Lockport, N.S., to Sable River, twenty miles, $64,000; Inverness and Richmond Railway Co., extension from Broad Cove to Cheticamp, C.B., forty miles, $128,000; railway from Bridgetown to Victoria Beach, N.S., thirty miles, $96,000; railway from point on Intercolonial Railway to Kempton, N.S., four and a half miles, $14,400; railway from Brazil Lake, on Dominion Atlantic Railway, to Kemptville, N.S., eleven miles, $35,200; Montfort and Gatineau Colonization Railway Co., extension from Arundel, thirty miles, $96,000; Chateauguay and Northern Railway Co., bridge from Bout de L'Isle to Charlemagne, junction of Ottawa and St. Lawrence; $150,000; Chateauguay and Northern Railway Co., bridge across Lac Ouareau river, $15,000; Arthabaska Railway Co., for railway from Victoriaville to Chester West, P.Q., twelve miles, $38,400; Great Northern Railway Co., branch from Joliette towards Ste. Emilie, twenty miles, $64,000; railway from Farnham, Quebec., to Frelighsburg and International Boundary Line, twenty-one miles, $67,200; construction of bridge over St. Francis river, $50,000; construction of bridge over Nicolet river, at Nicolet, $15,000; railway from Halifax to a point on Central Railway of Nova Scotia, $64,000.

Marine News.

The Jones & Moore Electric Co., Toronto, has received an order for a new automatic incandescent dynamo for the steamer "Lakeside."

The R. & O. steamer "Spartan," which was stuck on rock in the Lachine Rapids, was released by the Calvin Wrecking Co. in a remarkably skillful manner.

By making 37 knots over a measured course, the turbine torpedo boat, "Viper," recently built for the British Admiralty, has broken all records, and has quite fulfilled the expectations of the inventor, Hon. Chas. Parsons.

It is worthy of note that the steamer "Arabian," which reached Montreal from Duluth, passed through the new Soulanges canal, drawing 13 feet of water. The time from Montreal to Duluth and return was fifteen days and twenty hours.

George Wilson, of the Irish Electric Railway Co. Ltd., is in Canada in connection with a proposal to form a company to establish a line of fast mail steamers between Ireland and a port in the Maritime Provinces, to make the ocean trip in three days.

The opposition of the Newfoundland Government to R. G. Reid's plan of turning his business in that island into a joint stock company is forcing Mr. Reid to float the various portions of his great enterprise as separate companies. The Reid-Newfoundland Steamship Co. with a capital of $2,500,000 has just been announced.

Speaking of Canadian competition in freight carrying The Buffalo Commercial says: The big steamship "Gratwick" left Chicago with 105,000 bushels of grain. At Milwaukee she took

on 1,500 tons of the package freight lying there and the complete cargo (on 18 feet of water), went to Depot Harbor, Lake Huron, in Canada, from which port it goes by rail to various points in Canada and New England. The "in" cargo of the "Gratwick" this last time to Chicago loaded her down to the 18-foot mark, and was a cargo of general merchandise, the wholesale value being about $900,000.

The report of the United States Deep Waterways Commission, appointed in 1897, to investigate and report on the routes for deep waterways between the Great Lakes and the Atlantic, has been published, in a condensed form, by the Secretary of War. The commission finds that the most favorable route for a 30-foot waterway is from Lake Erie to Lake Ontario, via La Salle and Lewiston, and from Lake Ontario to the Hudson River via Oswego and the Mohawk Valley; for the 21-foot waterway the same route. It is stated that the proposed route is entirely within the United States, and the season of navigation is longer than a more northerly line would have. The estimated cost of the 21-foot waterway, on the low level plan, is $206,358,000; that of the 30-foot waterway is $317,284,500. The annual cost of maintaining and operating is estimated at $2,343,478 for the former, and $2,930,308 for the latter. The commission believes that the 21-foot waterway offers a greater return of value, relative to its cost, than the 30-foot waterway.

VENTILATION AND HEATING.*

BY W. B. SNOW.

From the apparatus the air may be conducted by underground ducts or overhead pipes to its proper destination. Inasmuch as the heat results are secured by discharging the heated air above head level in a horizontal or slightly downward direction and towards the outer walls, it is usually most convenient in a one-story factory building to carry the piping overhead in the manner shown in Fig. 7. In this case the apparatus is supported upon a platform in one corner of the building, because of the proximity of the exhaust steam supply. The hot air piping is supported overhead, and carried entirely around the interior. Air as a rule is returned from the building, but the large window area with consequent leakage is sufficient to bring about a constant air change to meet all purposes of ventilation.

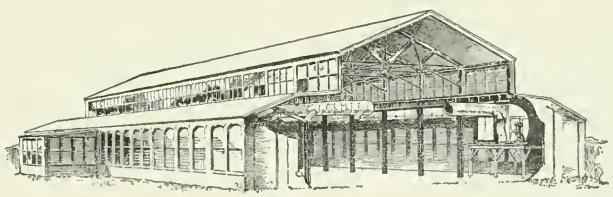


FIG. 7

The fan in such a building is usually operated at a maximum speed corresponding to the circumferential velocity of the wheel of about a mile a minute. The velocity of discharge through the outlet in the casing then approximates 3,500 feet, which, however, will be decreased in proportion to the resistances of the piping system. Although low velocities are evidently conducive to an economical movement of air, the objection to large ducts necessarily limits their size, while the customary utilization of the exhaust steam from the fan engine reduces the possible saving to a very small amount.

For factory heating, the main discharge pipe leading from the fan is generally of the same area as the outlet. The resistance of branches is compensated for by increased area, so that the aggregate area of the outlets will range from 25 to 40 per cent. in excess of the fan outlet, and the corresponding discharge velocities will be decreased to 2,800 or 2,500 feet or even lower where the resistances are great.

It is frequently possible in a building of the character just presented, to secure satisfactory circulation of the air with a limited extent of ducts by discharging the air at high velocity, and thus compelling it to continue its direction of movement for a considerable distance without the use of conducting pipes. There are other cases, however, where, owing to the presence of obstructions within the building, the air can be forced only a short distance from the pipe outlet, and local distribution is necessary. Such is the condition presented by the ordinary passenger car paint shop.

A similar problem is presented in the case of a locomotive roundhouse, where the main distributing pipe must constantly change direction to conform to the circular shape of the building. Here the fan system serves a double purpose. It effects a general heating of the building by discharging the air towards the walls on either side, and at the same time is utilized as a means of rapidly melting the snow and ice from the running gear of the locomotives. This is done by conducting a portion of the air to the pits and there discharging it immediately beneath the locomotive.

In the familar gallery type of manufacturing building, the problem of air distribution becomes somewhat more complicated because of the impossibility of carrying pipes across the central space through which the crane travels, or of successfully forcing the air across this space. It therefore becomes necessary to provide for distribution upon both sides. Two methods are employed. In the first the apparatus is placed in the building adjacent to the boiler and engine rooms, and discharges the air through underground ducts to galvanized iron flues, placed against the walls on both sides of the building. From these the air is discharged along the walls above head level. In the second arrangement, presented in Fig. 8, two independent apparatus are employed. They are placed in the galleries midway of the length of the building, and each delivers the air to a double system of pipes, one for each floor, whence it is discharged toward the outer walls. This is an ideal arrangement for the return and reheating of the air.

In any installation the first cost is dependent upon the number of individual units in the heating system. In the ordinary building a single apparatus is usually most desirable, but when numerous connected structures are to be warmed, it is generally expedient to divide this into a number of independent units.

We here approach the problem of regulating the air volumes admitted to ventilate the various rooms as to maintain different temperatures therein when so required. When the temperature of the entering air is constant, as is the case in a single-pipe system, regulation can only be secured by changing the volume admitted.

Under the extreme conditions of factory heating, with outdoor air at zero, and an internal temperature of 70 degrees, the latter is maintained by admission of hot air at a temperature of about 140 degrees in sufficient quantity to change the volume within the building once in about 16 minutes.

In buildings of more than one story, the simplest arrangement for heating consists in placing the apparatus on the lower floor or in the basement, and delivering air into one or more vertical flues from which it is discharged through suitable outlets upon the several floors. In a wooden structure or in one of brick or stone which is already built, such distribution must be made by means of galvanized iron pipes.

In a new brick structure, however, pilaster flues may be build against the outer walls along one side of the building, and the air discharged therefrom toward the opposite side through openings at eight or more feet above the floor. The modern textile mill, with its symmetrical design, is manifestly adapted for such an arrangement.

(To be continued).

*A paper read before the Applied Science Society of McGill University, session 1899-1900.

THE LEAD AND ZINC INDUSTRY OF SOUTH-WEST MISSOURI.*

BY F. W. DRAPER, B.SC.

The great lead and zinc-producing district of south-west Missouri occupies the extreme south-western part of that State, and extends across into south-eastern Kansas. The bulk of the mining has been done up to the present time in a comparatively small area, probably 45 to 50 miles in length from east to west, and 20 to 25 miles in width. In this district the towns of Joplin, Aurora and Granby, in Missouri, and Galena, in Kansas, are the centres of the mining industry. In this comparatively small area are found the greatest zinc blende deposits known to exist in the world. While both zinc blende and galena are found, the production of blende is far in excess of that of galena.

*A paper read before the Applied Science Society of McGill University, session 1899-1900.

The distribution of blende is not uniform over this whole area, but deposits of some value may be reasonably expected at any point. From the nature of the deposits, as will be shown, the distribution is necessarily very uneven.

Rocks belonging to the lower carboniferous series form the bulk of the area under consideration; limestone, cherts, shales, and sandstones are all represented, but limestones are by far the most abundant. And it is in the limestones that the ore deposits are found. The cherts are important only because the ore is almost invariably found in connection with them. The shales are important as a source of natural gas for use in the smelting industry.

The country is a greatly undulating prairie with no marked eminences. The strata are nearly horizontal, having only a slight dip toward the west. The ore occurs in great bodies of irregular shape, generally lenticular masses, sometimes as pipes and again as sheets. The width and thickness vary widely within distances of a few meters. Previous to the discovery of minerals of value in 1870—71, it was an excellent farming country, being well suited for raising fruit and grains.

The deposits almost invariably occur in irregular masses of chert. The chert is in form of angular fragments with zinc blende and galena in the spaces between the fragments, and crystalized on their faces. In some places the amount of chert is so small that the deposits assume the form of a solid mass of ore. In other places the chert is packed in such a manner as to leave very small spaces for the ores. At times stringers of ore are found extending out into limestone, which is free from chert, but a careful inspection failed to bring to my notice more than a few such cases, and it is quite certain that they are limited in number. The ore is found at depths varying from grass roots to 175 feet, and although the diamond drill has shown ore in paying quantities at depths below this very little systematic prospecting has been done. This is undoubtedly due to the large amounts of ore yet remaining in the shallower deposits.

At the surface much oxidized ore is found, but as depth is gained, the sulphide appears, and it is blende which constitutes the great part of the ore produced. The galena is found mostly nearer the surface, and then only in certain deposits. In the eastern end of the field the oxidized ores are much more persistent. Thus at Aurora silicate is abundant, while at Granby the Smithsonite is very commonly found. The local term for oxidized zinc ores is "silicate." The term "drybone," which is used in the Wisconsin field to designate zinc carbonate, is used here for cerrussite ($PbCO_3$). This latter mineral is not of very common occurrence. Associated with the ores of zinc and lead are other minerals, the most abundant being calcite, marcasite, dolomite and bitumen. The deposits are characterized by magnificent crystals of the various minerals. The arrangement of the crystalline aggregates has raised very interesting questions as to the deposition of the various minerals. Thus some specimens show crystals of blende on galena, and again pyrite or marcasite on the blende. Then, in other but rarer instances blende has been found crystallized on marcasite. But it is not the intention of the present paper to go into details of the mode of deposition; a discussion of this subject will be found in the reports of the Missouri Geological Survey. It may suffice to point out a number of the theories put forward. By some it is claimed that the deposits are due to deposition of ZnS from an alkaline solution. The blende was supposed to have been originally distributed uniformly through certain formations either above or below the subcarboniferous, and to have been dissolved by the percolating waters, which find their way with great ease through limestone. The blende was then redeposited wherever suitable conditions presented themselves. The chert, owing to its acid nature would destroy the alkalinity of the waters, and they would thus lose their power of holding the blende in solution. Thus the deposition would be on the pieces of chert. The chert is undoubtedly a secondary deposit, having resulted from the concentration of small amounts in the limestone into a larger mass of fragments at one point. It is not so easy to account for the angularity of the fragments, however. The suggestion that it is due to faulting seems hard to believe. It seems rather to be due to some action of the water which has caused a cracking to pieces of rounded masses.

This view of the formation of the deposits by concentration of small deposits disseminated through other formations obtains partial confirmation at least from the fact that throughout much of the territory contiguous to the workable deposits to the east, the rocks contain much blende and galena, disseminated over considerable areas in form of small pockets mostly of fist size and too few in number to make their exploitation profitable. That the blende was derived at least partly from older rocks is shown by the fact that the mine waters from the mines now worked contain blende in solution and articles like picks or shovels left lying in such waters become after a time coated with blende and galena. It is quite probable either that the mineral is brought up from below or that solution and deposition are going on simultaneously in the formation which contains the deposits. The view that the minerals came from older rocks is also confirmed by the fact that the limestones already spoken of as composing the country bordering the subcarboniferous area on the east are of lower silurian age and consequently older than the subcarboniferous.

It is not improbable that the zinc ores in the field under discussion were originally in a similarly disseminated state, and have been concentrated at this point because the waters percolating through the limestone were capable of holding zinc in solution, and met with suitable conditions for precipitation in this region. The fact that the blende and galena are in association with chert certainly points to an alkaline solution as the solvent, the alkalinity becoming neutralized by contact with chert, and losing its power of holding mineral in solution.

Others have maintained that the deposits are due to subterranean waters bringing the minerals in solution from great depths. Others assign to bitumen an important role in breaking up soluble zinc salts, presumably sulphate, with deposition of sulphide. The first of these two hypotheses seems improbable because of the form of the deposits, and the entire absence of any true veins, such as would be found had the solutions come from great depths. As regards the bitumen, while this substance is common in the limestone in which the ore bodies are found, and some is even associated with the minerals, the amount seems far too small to have accomplished so great a deposition, and the bulk of the bitumen is found in the limestone and away from the ore.

Still another hypothesis is that the minerals were held in solutions in sea water during the early periods of the earth's history, when the water was possibly hot, and of entirely different characteristics from the sea water of our time, and that the minerals were deposited "in situ," when the waters could no longer hold them in solution. This theory also seems improbable because the chert with which the ore is associated is manifestly a secondary deposit, and it necessarily follows from the fact that the blende is mostly found in crystals on the fragments of chert, that the blende is of secondary origin.

Methods of Mining.—Up to within the past year the exploitation of the deposits has been by a large number of individuals rather than by large companies. The leasing system was almost invariably followed. The owner of the land was rarely the one who mined the ore. He leased a certain small tract to one or more individuals, who were to pay a certain royalty. This was sometimes in the form of a cash payment, but more generally consisted of a certain amount on each ton of concentrates produced. Thus if no ore was found the miner paid no royalty in most cases. The field in and around the principal producing centres has thus become dotted with small mining plants. Some of these had steam-hoisting plants, but in many cases a horse or mule operating a whim, with a half oil barrel for ore bucket constituted the plant. In some places the shafts are not more than thirty or forty feet apart. The character of the deposits are such that while a shaft in one place may show only a small amount of ore, another, forty feet distant, may bring the lessee handsome returns. The abandoned shafts, many of which are not fenced in, make it dangerous to travel in certain districts after dark.

This method of leasing small tracts to individual miners was rendered possible by the small expense attendant upon the opening of the deposits. In many cases the miners found ore at the grass roots, and enough during the sinking of the shaft to nearly pay necessary expenses. And the shaft needed to be

The Canadian Engineer

VOL. VIII.—No. 5. TORONTO AND MONTREAL, SEPTEMBER, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR, R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE		PAGE
Alternators, Conditions Affecting the Wave Form of	98	Marine News	111
Civil Engineers, Summer Meeting of the Canadian Society of	93	Personal	112
Drill Holders, The Simplex	112	Power Factor as Affecting Operation and Investment, with Special Reference to Induction Motors and Enclosed Arc Lamps	100
Electrical Association, Canadian, The Annual Convention of	104	Quebec Electric Railway System, The	89
Electric Flashes	110	Railway Matters	111
Heating, Artificial	91	Stationary Engineers, Annual Convention of the Can. Association of	94
Industrial Notes	109	Williams, J. H. & Co.	108
Jack Screws, Little Giant	97		
Mining Matters	111		

—Owing to the length of our convention reports, references to the Toronto Exhibition and a quantity of news matter have been crowded out of this issue.

THE QUEBEC ELECTRIC RAILWAY SYSTEM.

BY D. E. BLAIR, CHIEF ELECTRICIAN OF THE QUEBEC RAILWAY, LIGHT AND POWER CO.*

In introducing his paper, the author remarked that Quebec presented a number of special difficulties as a field for electric railway enterprise. The city had a population of 75,000, of which 65,000 were French-Canadians. A large percentage of the population were not only limited in means, but lived in congested districts, near their places of employment, and consequently would have little need for street cars. The life of the city was of that easy-going character, where haste in getting about was not considered urgent; and, again, the phenomenally heavy snow falls—which sometimes reached ten feet on the level—seemed an insuperable obstacle, especially when the steep hills and narrow streets were taken into account. But the Quebec Railway, Light and Power Co. undertook the work, overcame the difficulties, and the successful operation of the street railway has brought new life and activity into the city.

*Abstract of a paper read before the Canadian Electrical Association.

Track laying commenced on the 1st November, 1896, and on July 1st, 1897, the road was open for traffic. The specifications for the track called for 72 lb. 6 in. steel T rails, 30 ft. long, to be laid to standard gauge, on 7-in. ties at 2 ft. centres. Each joint was double-bonded by 2-00 solid copper wire in copper bonding caps; these to be tinned and the ends of the wire riveted on the outside of the rail. There were double cross-bonds at every fifth joint—that is, every 150 feet. The total length of rails is 17.56 miles, of which 7.28 miles are single, and 5.14 miles double track. The poles are tubular iron ones, 28 feet long, weighing 700 lbs., and placed 90 feet apart. Trolley wire is No. 00, hard drawn; and the span wires are of galvanized steel, ⅜-in. Lightning arresters are of Wurt's non-arcing type. There are 10 miles of span wire and 2½ miles of bracket. There are two car sheds, one for the upper town and one for the lower town. The repairs are done in one of the sheds, where there are seven floored pits communicating with the machine shop and blacksmith shop beneath. It is found cheaper to manufacture repairs pieces than to buy them from dealers.

The streets, which had been macadamized, were stripped of macadam to the depth of a foot, leaving the ties exposed, the ties being filled around with concrete to within 4 inches of the top of rail. The street was then faced with scoria blocks between the rails and for 8 inches outside, and the rest of the street paved with asphalt or scoria. As visitors to Quebec know, rocky cliffs separate the Upper Town from the Lower Town, the latter extending in a semi-circle round the former. The streets of the Lower Town are extremely irregular, and some of them so narrow that there is scarcely room for an ordinary vehicle to squeeze past a car on a single track. The return track runs through a maze of narrow streets and alleys, turning at all angles, so that on one section of the line, a mile in length, there are no less than eleven curves of from 35 to 40 ft. radius, at intersections of about 90 degrees, one of which requires a reverse curve of 40 feet radius. On all these streets the inner rail comes within 2 feet of one sidewalk, in order to leave room for single vehicles to pass a car on the other side. The upper and lower towns are connected by two lines ascending obliquely along the face of the cliff. One of these cross town lines rises 172 feet in a length of 3,440 feet. This is an average grade of 5 per cent.; certain sections, however, having 12½ per cent.; others, 10 and 9 per cent., and others being nearly level. All these grades have sharp curves. One of them begins to rise at a gradient of 11½ per cent., and terminates at 14.15 per cent., with a curve of 40 feet radius at the top, the heaviest part of the grade. The other cross town line is 1,300 feet long, has an average grade of 6.85 per cent., and is carried along a part of the cliff by a steel trestle at a grade of 7.5 per cent. for 800 feet. One difficulty on this line is that when a car leaves the trestle to take the up grade, it

is running at half speed, and must be accelerated on grade, which means a heavy drag on the motor. The Upper Town system has a double tracked belt line, 3½ miles in circumference.

The speed on all lines approximates eight miles per hour. The Upper Town service requires four to seven cars, and the Lower Town eight to twelve cars; total average of cars in summer service 35; in winter, 30. Strict rules govern the operation of cars on grades and curves. On some of the grades stop-boards are placed at top and bottom, and the motorman cannot proceed till signalled by the conductor. Speed down grade must not exceed four miles per hour. As a result, runaway cars are very rare. Hand brakes are used throughout, the effective leverage being 100 to 1. The brake shoes are of very soft cast iron, and it is found that the retarding force of this shoe is more evenly applied and the coefficient of friction higher than when hard cast iron is used, especially in frosty or snowy weather. New shoes weigh 19½ lbs., and wear down to 4½ lbs.; the average life is 6,150 miles or 410 m. to the pound of wear. The wheels are of ordinary chilled cast iron, 33 inches diameter, weighing 425 lbs. each, and mounted on a 4-inch steel axle. During the first three years of operation there were 125 pairs of wheels removed, of which 94 pairs were worn out, or 75 per cent.; while 23 were "flats," being 18 per cent., and 8 had broken flanges, being 6 per cent. The average life of the wheels was 24,800 miles, though ten pairs attained a life of 49,000 miles.

The car equipment consists of thirty-five 28-feet double-vestibuled closed cars weighing with equipment 14,500 lbs., and seating thirty people; twenty-four double-end open cars, weighing 16,500 lbs., and seating fifty passengers; six double-ended snow sweepers, two wing plows, one street sprinkler, and one converted horse car.

The electrical equipment is of Westinghouse manufacture, and consists of 124 No. 12 A. 30 h.p. motors; 124 No. 28 A. controllers, and 62 sets of controlling resistance. All closed cars are in service the whole year, and the extra equipment required for sweepers and snow plows is borrowed from the open cars. The sweeper and snow plow equipments are necessarily much overloaded at times, the overload often being 100 per cent. for several minutes at a time during heavy storms; and sometimes a sweeper will burn out five or six No. 13 copper wire fuses—or in other words, draw 200 to 250 amperes at 520 volts before it can pass a difficult spot. This does not seem to have any bad effect, beyond the temporary softening of the armature insulation, and sometimes the loss of some solder from the commutator connections. Not a single armature has been burned out since the road was in operation; and the only repairs required were in resoldering melted connections. There has not been a commutator flashed or "bucked" in the past eighteen months. It has always been the practice to send an armature to the lathe at the first sign of a "buck," and this has been found the only way to prevent the trouble. A sharp eye has been kept on the brushes to see that they do not wear down too far or become gripped in their holders, and to see that commutators are cleaned and sandpapered about once a week with No. 0 sandpaper. The commutator should be sent to the lathe before it has worn down too far. As soon as a slight shoulder is formed at each side of the wearing surface, the brush is lifted by the end play of the armature and unnecessary sparking is the result. Moreover, the copper segments are seldom of uniform hardness throughout, and the least inequality of wear develops into a low spot on the commutator. It is important that the brush springs be set at the proper tension, and it is easy to make a rough test with a pair of calipers or steel tape line, and an angler's spring balance. It will be found that too light is just as serious a defect as too heavy tension. See that the brush holders are accurately aligned, so as to divide the current equally between the two circuits of the armature. The quality of the brush should be considered more than the price, because of its effect in prolonging the life of the commutator. The cost of renewing one commutator would keep a 50-car equipment in brushes for two years.

Some trouble was experienced during winter storms from the grounding of field coils, but means have been found to prevent this. During cold, dry snow storms, when light particles are flying about, two or three gallons of water may collect in the bottom of the motor casings. No trouble has arisen from the controllers, which have needed no repairs more than renewing the sparking tips of the drum, which is done about once in two years at a cost of 50 cents per controller. Apart from a nightly inspection of car and motors, etc., it is the practice to overhaul every car once in six weeks. This is done in the day time. Bearings and armatures are examined, brush springs set, brake rigging adjusted, and journal boxes examined. The result is there is seldom a block in traffic from a disabled car.

The maximum current required to get a car up the steepest grades in summer is constant at about 125 amperes, or less, at 520 to 540 volts, the average being from 60 to 80 amperes per car. In winter, however, when wheels begin to skid from snow and ice, the overload is often beyond the capacity of the heaviest fuse it is safe to use on the car, viz., 14 B and S. This wire will carry 180 amperes for several minutes, so that one gets an idea of the power required. Every equipment on the road has often to stand an overload of 50 to 120 per cent.; while in the case of the sweepers the overload is sometimes 200 per cent. Only one mishap has occurred to a sweeper from this cause. The total cost of maintenance of electrical equipment per car mile per year is 0.17 cent.

The staff consists of seventy motormen and as many conductors. Before being accepted, a motorman is in training three weeks or a month, part of the time being spent on the road and part in the car sheds, as a helper to the mechanics. He is then examined as to his knowledge, before being put to work.

Owing to the heavy fall of snow in Quebec, winter operations present exceptional difficulties which have been overcome to a greater extent than was ever expected. It is the practice to send out the sweepers as soon as a certain amount of snow has fallen, and these are followed by the wing plows round the whole length of track, at regular intervals, pushing the snow piles back as far as 6 feet from the rail—wherever that is possible. If the snow continues to fall the swing of the plows is reduced gradually down to 2 feet, or even less.

though in that narrow channel it is hard to keep everything moving. There are some bad spots, however, where it is necessary to keep gangs of hand-shovellers at work. Still, only once in 1898 and once in 1899, and then only for a day, was the service suspended. Nearly all the cars carry side brooms or flangers, about 3 feet long, set obliquely across the rails, about one foot ahead of the front wheels. These consist of a cast frame into which are fastened a number of cuttings from the sweeper brooms, about 10 inches long. They cost little and have proved valuable, especially where there are intervals of half an hour to an hour between the passing sweepers. In fact, these are often sufficient to get through a light snow storm without the sweepers; while from their use the sweeper brooms need not be let down so close to the pavement. A good deal of loss of rattan is thus saved. One can appreciate the magnitude of snow expenses by the fact that $1.54 has to be deducted from the daily gross earnings of every car during the whole year to make up the amount.

All closed cars are heated electrically during six months of the year. There are two sections of heaters on each side of the car, each pair being separated by a controller. In four months of this time it requires 5.1 k.w. to heat a car, both sides being in use; but in November and April one side is enough to heat it comfortably. Taking the average of car service per day as 18 hours, the cost in current of heating a car is 3.2 cents per hour, or $87 per year. This is equivalent to .204 cents per car mile, and the moral is, don't use electric heaters in a very cold climate, unless you have the advantage of unlimited water-power.

The railway, as well as nearly all lights and motors in Quebec, are operated through a sub-station within the city from a power-house situated at the Falls of Montmorency. The power-house contains three 600 k.w. two-phase S.K.C alternators; one 750 k.w. alternator; one 600 k.w. double current, 275-500 volt, Westinghouse generator, and two 30 k.w. bi-polar exciters. All the larger machines are direct connected to 52-in. water wheels of 1,000 h.p. each, running at 286 revolutions per minute. The power is sent to the city over sixteen wires carried on two separate pole lines. Each machine is fed into a separate circuit at Montmorency, but may be connected in parallel at the city sub-station. The sub-station has two 600 k.w., two-phase S.K.C. synchronous motors taking current at 5,000 volts, and are direct connected by two 500 k.w. 500 volt G.E., railway generators. There are also two 200 k.w., two phase, 5,000 volt synchronous motors direct connected to four 125-light multi-circuit Brush arc light machines. Besides, there are the starting motors, transformers, switch boards, etc.

Before concluding his paper, Mr. Blair gave a short account of the electric railway to Ste. Anne de Beaupre, which is referred to elsewhere.

In reply to questions, Mr. Blair stated that one of the peculiar conditions of operating in Quebec was that the heaviest grades carried the heaviest traffic. They had comparatively little trouble from slush in winter, but the chief trouble was the dry, powdery snow, which flew about and lodged in the motor casings, where it melted. The actual cost of snow cleaning to the company was $16,300 per season. The snow had in some places to be carted twice, once to remove it from the street, and again to move it from the snow dump to the river or common. It sometimes fell to such a depth that in drifty spots in certain streets it would be 4 feet above the top of a car. Under the general by-law the tenants pay for cleaning the snow from the streets, and the tenants on the street car lines now contribute 15 cents per running foot per season towards the company's snow cleaning work.

ARTIFICIAL HEATING.

BY W. M. WATSON.

(Concluded from last issue).

The radiators used to distribute heat from low pressure steam may be constructed on the bayonet principle, because they receive the steam at the base, which answers as a receiving box, from there the steam can rise up each bayonet pipe or link, and as it cools, the drip water falls back to the base, and from there passes down the inner wall of the rising steam pipe to the boiler.

The cast-iron radiators, most suitable for hot water or exhaust steam, should have the inlet feed pipe at the highest point, and should have a clear and direct passage through all the links at the top and at the base, so that the water or exhaust steam can fall down from the top of each link of the radiator in a bee line to the base, and onward down the return pipe. The waterway in each link of a cast-iron radiator should have narrow channels dividing the water passing through them into thin, broad streams, causing a small amount of water to serve for plenty of heating surface.

Heating by low pressure water calls for more radiating surface than when heating by steam or high pressure water, because the radiators do not deliver the heat to the rooms at so high a temperature as steam. Three feet running of 1-inch iron pipe is reckoned to have one foot of radiating surface, and one foot of radiating surface, whether from pipe or cast-iron, is calculated to heat 30 to 50 cubic feet air space in an enclosed room of a dwelling, office or school; 60 to 80 feet in assembly halls and factories, and 90 to 120 feet in churches. All the measurements named are subject to alteration, on account of the construction and position of the building and the windows, etc., causing practical judgment to be always necessary. Usually these proportions are expected to heat to 70 degrees when the outside temperature is at zero, if there is sufficient boiler power. The apparent financial loss in having to buy more radiators for low pressure water heating than for high pressure or steam heating is more than balanced by the extra cost of materials needed for steam, etc., and by the smoothness with which the low pressure water heating works, and the trifling care and attention it needs when in action. When a fire is radiating heat towards a plate, or the hot gases from the fire passes over a plate that is nearly the same temperature as itself, the plate cannot extract any heat from either the gases or the fire, and the greater the difference there is between the heat of the fire, or the gases passing through the flues of the boiler, and the water the boiler contains in favor of the furnace, the more rapidly will the heat be transmitted to the water, and the more units of heat will the water absorb. Mr. Jones tested the heating powers of a furnace on absorbing plates, at

various temperatures, using a strong atmospheric gas burner in place of a furnace, and started to count when ten gallons was at 60 deg. Fah., registering the temperature of the water every fifteen minutes. First quarter of an hour it increased the temperature to 92, or 32 degrees; second quarter to 116, or 24 degrees; third quarter to 138, or 22 degrees; fourth quarter to 158, only 20 degrees, or less, by 12 degrees, in the fourth quarter than in the first quarter of an hour. This shows that as the absorbing medium approaches the radiating medium in temperature, the loss of heat is 12½ per cent., and on that ground, to heat a house with the lowest possible amount of fuel, we must heat with a radiating medium at the lowest possible temperature that will give satisfaction, or the temperature necessary to keep the room comfortable, which seldom needs a radiating temperature of over 150 degrees. Another point in favor of low pressure heating is that when heating at the low temperature, the 150 degrees quickly gives off a third, at least, of its heat, and the water hurries back to the boiler to get replenished, which causes a quick circulation over the fire, and a quick circulation makes a pound of fuel give up more units of heat, by far, than it will when there is a slow circulation. There is a marked difference in the power to absorb heat from the rays of a fire, or from the gases escaping from the fire, and by securing heat by a plate being immersed into the body of the fire. This can only be proved by placing a piece of metal in the body of the fire, and holding a similar piece over it. The one in the body of the fire will quickly rise to a temperature equal to the fire itself, the other hanging over and acquiring its heat from the rays of the fire, will not rise to half the fire's temperature. It is by close relation of the source of heat and the absorber of heat, that the best method of heating is secured. This idea is well marked out by Perkins, when constructing the boilers to serve his high pressure water apparatus. He makes them of hydraulic pipe placed in close circles round the fire, forming the walls that keep the fire in its place, and Johnson makes an improvement, and causes the small 1-inch hydraulic pipe to act as fire bars to bear the fire, and as girders to bear the crown arch that covers the furnace, so, between their two ideas, with a few necessary improvements added, which seem to be needed in each of their methods, a boiler could be constructed that would be ahead of any water heater yet made.

In closing this part of my subject, let me remind the reader that with low pressure it costs less to secure heat from circulating water than by any other principle of artificial heating. It is easy to understand, durable in construction, reliable in action, and requires very little attention, and continues to work smoothly so long as the fire is kept up.

Let us now say something about boilers, and first point out the idea put forth by R. W. King, in the Canadian Engineer for May and June, 1900, where he shows that boilers at present used for the purpose of domestic heating are not scientifically built. To my mind he rightly holds that the coolest gases should pass by the coolest sections of the boiler, and the fire box, and the water plates that acquire the highest temperature in the boiler should also come together, then the heat from the gases to the water would be considerably improved in transmittance. Though the Lancashire boiler holds too much water in bulk, it makes a rapid and coal saving heater. Owing to the way the boiler is set, and the method in which the flues are constructed, it will always be a rapid and scientific steam generator. B. G. Nicol by his experiments proved that water will acquire more units of heat when the pipes or plates are horizontal than when they are standing vertically. The Lancashire boiler sits horizontal; the furnace box is fixed in a position that it passes right through the solid body of water at a point very near the surface of the volume of water the boiler contains, which is the point where the water rises to the highest temperature and vaporizes. The flames from the coal fire go to the rear end, and are divided into halves; one-half is carried along on each side of the boiler plates outside the shell, until they reach the front end, and there the gases again amalgamate, and pass under the boiler shell at its lowest point, and at the point where the water contained in boiler is also at the lowest temperature; therefore at a suitable temperature to absorb plenty of heat from the hot gases, so long as they travel near the boiler. The best form of boiler to heat water is the one that divides it up into thin ribbons, in pipes small enough to compel rapid movement, and so that the hot gas can envelope them all round. Heating by rapid circulation of water through pipes is very much safer and can be done with less fuel than by a Lancashire boiler, that compels the water as it heats to rise up to the crown by self-circulation. But I believe that if it were possible to construct a long tubular boiler with tubes as small, and set as close together as the tubes are set in the upright boiler of the Ronald's fire engines, and at the same time be able to keep them clean from soot and dust inside the tubes, and calcareous scale on the outside, and the boiler was set in a horizontal position, we should have a rapid heater that would use the least amount of fuel, and a vaporizer that would be far ahead of every other boiler yet made. But such an idea seems impossible, in the form of a tubular boiler. There is no difficulty in constructing a boiler in the form of a group of iron pipes, and proportioning the flow so that the water will flow evenly through each pipe section, and keep the machine thoroughly clean. A boiler set in brick keeps the plates at an almost uniform temperature; therefore, they expand almost uniformly, and no damage ever occurs from unequal expansion. But when the outside shell of the water-bearing boiler is exposed to the atmosphere, and the centre of the same plates are subject to a fierce heat, then the expansion is very unequal, and something generally gives way. There is one disadvantage in boilers made solely of small iron pipe, because they are usually set in a casing of brick, which appears to extract a large amount of heat from the fire. When such boilers are used for heating, the heat absorbed by the casing, whether it be composed of iron or of brick, can be put to profitable use by expending a few more dollars, and constructing the casing so that it becomes a heater and circulator of air; this would give the premises a combined hot water heater and hot air furnace.

We have before given some idea how much radiating surface is necessary to heat rooms, and we can only venture to state what is the approximate amount of absorbing surface the boiler requires to heat the radiators; in a house with double doors and windows, and

built in a place shielded from the north and east winds, and that can have frequent sun baths, one square foot of heating surface would supply heat to 18 feet of radiating surface. If the building has plenty of single glass, and doors, and besides is exposed to the coldest winds, and to add to its disadvantages, has been poorly built, heating surface of one foot for every six feet of radiating surface might be little enough reckoning on the principle of heating to 70 degrees when the weather is zero. In choosing a boiler, some will be found with considerable heating surface that will quickly get covered with dirt and soot; this reduces its heating powers. Others have not direct, or even-sized channels for the circulating of the water; such boilers will allow scale to form inside, and reduce their capacity for absorbing heat. Some are so short in the flues or passages for the travel of the gases, that the gases reach the chimney before the heat that might be extracted from them is absorbed by the boiler. Some boilers set in brickwork are sometimes set with the flues turned in a way that the heat and gases radiate on to the face of the brick, in place of hugging the boiler plate, and a large portion of the heat is wasted in that way. Some years ago, I engaged a bricklayer to set a cast-iron cannon boiler, which makes a good heater, because the whole of the outside shell, and the large interior flue is fully enveloped in flame when properly set in brickwork. When completed, no amount of fire could raise the cold water twenty degrees of temperature, but when it was altered, and each of the five flues passing along the length of the boiler was made to turn, in a way that the hot gases hugged the absorbing surface plates of the boiler in every division of the flues, it heated both quickly and well. Another point to be observed in selecting a boiler is to be sure that the metal can expand evenly, as has been already referred to. Scale can be prevented from attaching itself firmly in a steam boiler by placing a few gallons of the best quality of coal oil in the empty boiler, then allow the water to enter very slowly, so that as the water rises, the oil will have time to paint all the plates and rivets, and when full let out the oily water and fill for use. When the boiler is again empty for cleaning, the accumulated scale will peel off easily. We must now study the important subject of the action of air in heating apparatus. When the boilers are set on a higher plane than the radiating pipes, which they often are in railway cars and places where there are no lower rooms, the style of arranging the pipes to cause the water to lift back to the boiler, makes it hard to coax the air to leave the pipes, and water cannot circulate through them so long as air is present in any part of the circulating system. Fresh water contains about 5 per cent. of air, which separates from the water when the water approaches the boiling point. In hot water apparatus, where the water seldom reaches that high temperature, it is sometimes weeks before it is all out of the water, and if the apparatus is not constructed on the self-air relieving principle, and hand air-traps have to be depended upon, the apparatus does not give a high-class service until all the air is boiled and let out. I have seen both boilers and radiators out of which it was impossible to get all the air, on account of having pockets or chambers that could not be cleansed by the currents of water in circulation, and the stream passed them similar to a person passing an open door. It is held by some that such air chambers have no effect on circulation, and this might be correct if air was not elastic, and could not be pressed into small bulk; but this fact gives it the privilege of acting similarly to a rubber ball, and occasionally taking a whim and expanding partly into the adjoining water channel, and retarding the speed of circulation. A very small quantity of air can act similar to a cut-off valve in a pipe, a boiler, or a radiator.

In low pressure steam heating air is very obstructive until the whole water used in the system is thoroughly relieved of its presence. In this kind of heating, the water is vaporized and the air is separated from the steam; air at the same temperature of steam is about 38 per cent. heavier per cubic foot. Low pressure steam heating is, when it arrives at the radiators, a gravity system in its action, because it neither passes through nor properly circulates in the interior, but genally approaches the inner walls, and there condenses to water. The heated air has not as much elasticity as vapor, yet it will travel along in the pipes with the steam, and will enter the radiator, but having traveled so far it comes to a place where there is no right of way through, and, as air declines to descend, therefore, it cannot return into the pipes, nor can it condense to water, so it cannot copy the example of the steam and dribble back down the pipe it has come up, and being heavier than steam, it must lodge at the bottom of the radiator, under the column of steam which heats the links above it. In this form it often seriously impedes the proper heating of the radiators, and should be let out. To let this heated heavy air out, there needs to be an air tap at the lowest point of each radiator, besides the one at the head, used to let out the air that the radiator contains before filling with steam; in fact this atmospheric air would be forced to the bottom by the light, hot steam, rising up to take its place, so that only the low air tap is, perhaps, necessary. It is an unwise policy to let out the water from the apparatus except when needed for repairs, but only let out the accumulated dirt or scale from the lowest point of the boiler, because in every fresh filling the air must be reckoned with, and also the salts, iron, lime, etc., that the water contains, and distils out when vaporized, setting up a chemical action, with the interior walls of the iron, boiler and pipes, etc, at points where the circulation is slow, or where the water stands motionless in pockets or chambers that are not in the direct route of the circulation current. The more fresh water that is added to any system the more of this objectionable air and calcareous matter gets inside of the apparatus, jeopardizing the heating, radiating, and circulating advantages.

SUMMER MEETING, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The first of the regular summer meetings of the Canadian Society of Civil Engineers was held in Ottawa on the 13th, 14th and 15th of this month, when visits were paid to the Eddy mills, the Booth mills, the new calcium carbide works, the new interprovincial bridge, and other points of interest to civil engineers, the last day being devoted to a trip over the Canada Atlantic to Parry Sound. Further reference to the excursion will be made in next number.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Toronto, the birthplace of this association, so far as the province of Ontario is concerned, had the pleasure of welcoming it for its annual convention. The convention held its sessions in the C.A.S.E. hall on Victoria street, and the opening session was held on Tuesday morning, 28th August, with President Huggett, of Toronto No. 1, in the chair, in the absence of the executive president. In a few well chosen words he welcomed the delegates. Letters of welcome were read from the Mayor and others. The executive president, R. C. Pettigrew, on arriving, replied to the address of welcome, and proceeded at once to business. The following delegates answered the roll call: J. Huggett, H. E. Terry, A. Storer, N. V. Kuhlman and W. J. Webb, all of Toronto No. 1; G. W. Dawson, Hamilton No. 2; W. Steeper, Dresden No. 8; W. F. Chapman, Brockville No. 15; J. Uttley, Waterloo No. 17; W. Oelschlager, Berlin No. 9; A. Ames, Brantford No. 4.

The executive officers present at opening were: President, R. C. Pettigrew; vice-president, G. C. Mooring; secretary, A. M. Wickens; treasurer, C. Moseley; conductor, W. Oelschlager; door-keeper, W. Bear.

PRESIDENT'S ADDRESS.

President Pettigrew, in his annual address after welcoming the delegates and thanking them for the honor of electing him unanimously to the presidency, said: The number of very important questions coming before this convention should receive your earnest and careful attention. The matter of plebiscite vote on bi-annual conventions will be brought up for debate. The report of the committee re bill for Legislature is one we should consider well, as this is the most important matter before us. I trust the committee will have it in detail, as each delegate will have to report to his association, and it is essential that we keep right on, and not give up until we have been successful in having the bill put through. I may say that within the last two months three men who operate threshing engines enquired of me about certificates and the method to get them. This is very encouraging, as it indicates that even in the rural sections engineers are considering the necessity of qualifying themselves for certificates. You will see, by the secretary's report that we are gaining ground. The old constitution has been revised, and charters for new associations signed. At last convention you made an excellent selection of a secretary in electing Past President Wickens to the office. In connection with the duties of this office a great amount of work is entailed, and Bro. Wickens has succeeded in keeping in touch with every officer of the executive, as well as each subordinate association. The lesson papers in circulation last winter had the effect of bringing every member to think, and although some are old and scholarly men, there is yet something to learn and to teach. This feature in connection with our association should be continued every winter, and even should some of the papers and lessons be repeated, there are always young men coming into the association to whom such lessons would be a material help, as well as having the effect of perfecting ourselves in the different subjects taken up.

The president then appointed the following committees:

Committee on Credentials—J. G. Bain, C. Moseley, J. Uttley. Committee on Finance—Jos. Smart, H. E. Terry, G. W. Dawson. Committee on Mileage—A. Storer, W. J. Webb, W. Steeper. Good of the Order—J. M. Dixon, W. F. Chapman, J. Huggett, A. Ames, W. Bear and W. Oelschlager.

On motion of H. E. Terry, seconded by J. Huggett, the president's address was referred to the Committee on Good of the Order for report.

The report of the Committee on Credentials was received and the committee discharged.

Secretary Wickens read the minutes of the last meeting, and after inserting the clause re the plebiscite vote, which had been omitted from same, the minutes were adopted and the secretary then gave the below report, which was referred to the Committee on the Good of the Order for discussion.

SECRETARY'S REPORT.

In presenting this the 11th annual report of the secretary I beg first of all to thank the officers of the subordinate associations for their promptness and courtesy in acceding to all our requests. Your secretary's report last year at the Berlin convention showed a total membership in good standing of 297 members. Montreal No. 1, consisting of 58 members, concluded to withdraw, thus leaving us only 239 members to start the year with. The several enquiries regarding new associations, reported at our last meeting, have all been answered and worked up, with the result that one new association has been formed at Vancouver, B.C., and a good prospect of one at Sarnia. We now have 10 associations that have lapsed, but of this number several are beginning to show signs of coming to life again. Our monthly papers, as ordered by the convention, were issued for five months, and have had a beneficial effect, both upon the active members as well as those who are not identified with us. I would strongly recommend the committee on Good of the Order to consider the advisability of extended work along this line. Our legislative business for the year was very strongly pushed by the joint committees of the C.A.S.E and the O.A.S.E., and very ably championed by H. H. Carscallen, M.P.P., who is the solicitor for the O.A.S.E., the measure was very ably put and defended both before the House and before the select committee, with the result that our hands are very materially strengthened for the next session of the House. I would also recommend to the convention that the action of the legislative committee of the Brotherhood of Locomotive Engineers in reference to our law be referred to a special committee, with instructions to try and remove the opposition now being put forth by that body. I would also like to impress upon the secretaries of the different branches that our half-yearly reports are due in January and July of each year. Our present membership is as follows: Toronto No. 1, 124; Hamilton No. 2, 31; Brantford No. 4, 5; Dresden No. 8, 7; Berlin No. 9, 13; Brockville No. 15, 12; Waterloo No. 17, 11; Toronto No. 18, 38; Vancouver No. 19, 16; Calgary No. 1, 0 members. Making a total of 266 members, a net gain (after deducting Montreal No. 1), of 27 members for the year. The receipts and disbursements for the year including our handbook account are as follows:

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

RECEIPTS.

Treasurer	$ 28 85
Charter	15 00
Stationery	32 53
Per capita	118 25
Hand book	87 88
Donations	38 25
Total	$320 76

DISBURSEMENTS.

Paid treasurer	$211 63
Charter expenses	2 00
Stationery and printing	50 60
Legislation	25 50
Postage	10 50
Berlin convention	5 50
Cash on hand	6 03
Total	$320 76

I have succeeded in getting our hand-book business partly settled. According to the statement sent in last year by Jos. Robertson the balance was $147.50 due the association. I have succeeded in collecting $87.88 of that amount, and also in finding that about 100 books cannot be collected for, leaving about 85 yet to hear from. I have received the appended vouchers and statement, re the Calgary charter, from Bro. Robertson of Montreal.

A. M. Wickens, Secretary.

TREASURER'S REPORT.

The treasurer's report was as follows:

RECEIPTS.

August 23rd, 1899, received from Bro. Mooring	$ 75 04
March 22nd, 1900, received from Bro. Wickens	84 88
July 25th, 1900, received from Bro. Wickens	76 75
August 24th, 1900, received from Bro. Wickens	50 00
	$286 67

DISBURSEMENTS.

Sept. 7th, 1899, paid Bro. Wickens, postage, etc	$ 2 00
Nov. 2nd, 1899, paid Bro. Wickens	22 34
July 25, 1900, paid for cashing cheque on Montreal bank	15
Balance on hand	202 18
	$286 67

Chas. Moseley, Treasurer.

Some members being also members of the Canadian Electrical Association, now in session at Kingston, it was decided on motion by H. E. Terry, seconded by A. Ames, that the business of the C.A.S.E. be rushed through in time to allow these members to attend the electrical convention, therefore a two-day limit was decided upon.

J. M. Dixon then gave notice of motion that in future the annual date of convention be decided by the executive. This was forwarded to the Good of the Order Committee for settlement.

Before adjournment for lunch the president called the attention of the convention to the fact that for the first time in five years Brantford had managed to send a delegate, and expressed on behalf of the executive his pleasure in welcoming their delegate, A. Ames. The convention then adjourned until afternoon.

Jas. Smart, chairman of the Committee on Finance, read the financial report (included in the secretary's report), and on his motion, seconded by H. E. Terry, the report was accepted.

A. M. Wickens read the report of the Committee on Mileage, and it was adopted on motion of A. Ames, seconded by G. W. Dawson.

The Good of the Order presented the below report:

Clause 1.—Resolved, That the president's address was of a hopeful and congratulatory character, showing also a careful consideration of the manifold questions affecting the association's interests. Adopted unanimously.

Clause 2.—Resolved, That the executive secretary's report was complete in the details necessary for our development as an association. Adopted unanimously.

Clause 3.—Resolved, That C.A.S.E. membership while not showing a great increase had been held together firmly, largely by the individual efforts of the executive secretary. We wish to impress upon the members as a society that there are numbers of men in our profession eligible candidates for our society who might be reached if we presented a united effort towards them. We recommend further, that deputations be appointed from time to time to address mass meetings of engineers called for that end by the executive, who should be instructed to provide delegates and funds for such purposes. This clause called forth a lively discussion. The word "union" was used in the place of society in the second sentence, and as a word conveying a wrong idea of the aims of the society it was objected to by H. E. Terry and C. Moseley, the general argument being that the society had been often misunderstood by the employers of engineers. They, the employers, as a rule, were not aware of the fact that the C.A.S.E. was an educational body, pure and simple, and the sooner that was understood the better. The following preamble in their constitution was clear on that point: "This Association shall at no time be used for the furtherance of strikes, or any way interfering between its members and their employers in regard to wages, recognizing the identity of interests between employer and employee, not countenancing any project or enterprise that will interfere with perfect harmony between them; neither shall it be used in any manner for political or religious purposes."

The clause under discussion was also handled from another point of view by J. Huggett, A. M. Wickens and W. J. Webb, and suggestions were offered freely as a remedy for the loss of outside branches already incorporated but allowed to lapse through want of interest on the part of the executive. Suggestions were made to call in the aid of deputies to visit the branches at stated intervals. This was objected to on the score of expense, and finally a compromise was made by a decision to have the different branch associations send representatives to towns in their vicinity to promote the organization of new associations, and the clause was adopted, as amended, on a motion by J. Huggett, seconded by N. V. Kuhlman.

Clause 4.—Resolved, That the association during its efforts to secure legislation at the last session of the House was materially hindered by the opposition of a sister society, who issued a written protest unfavorable to our interests, and while we do not propose to deal with them in the spirit of retaliation we are of the opinion that they must be laboring under an erroneous opinion to attempt to prevent us from obtaining legislation which would be of universal advantage. We desire to endorse our executive secretary's suggestion that a special committee be appointed to correspond with this sister organization with a view to enlightening them and ultimately having this opposition removed, and their support obtained. Adopted unanimously.

Clause 5.—Resolved, That the executive be instructed to issue a strongly worded circular prior to each half-yearly return made by the secretaries of primary branches urging the necessity of making such returns punctually.—Adopted unanimously.

Clause 6.—Resolved, That the issue of the lesson papers be continued, as apart from their educational value they keep the members in touch with each other, and such cohesive value should not be overlooked. It was also recommended that the papers be mailed to secretaries of the primary branches for distribution. The above clause was the subject of much discussion, and was finally laid over till next day.

The delegates and their friends after adjournment had a photograph (here reproduced) taken while standing in front of the entrance to the Freehold Loan & Saving Co.'s fine building. The Reception Committee had made arrangements for a drive round the city, and about a dozen carriages were in waiting. The first visit was to inspect the De la Verge system of refrigeration at the O'Keefe Brewing Co.'s plant. The reception tendered the visitors here was hospitable. The following few items are of interest to our readers: Three 100-h.p. boilers are used, also a 35-h.p. dynamo; the refrigerating machinery has a capacity of 50 tons, and in the plant are no less than 15 pumps, mainly 4 and 6 h.p. capacity, and all machinery used in this establishment, including the bottling and labeling and washing, is power driven; nearly 20 miles of pipe is used in the different departments, and the brewing capacity of the plant is 7,000 gallons per day.

Returning to the hall the announcement was made that C.A.S.E. No. 18 had extended an invitation to the delegates to meet at their hall on Bathurst street at 8 p.m., when papers would be read by members. When the meeting opened at the hour mentioned there was a good attendance. President Thos. Graham welcomed the visitors, President Pettigrew replying.

The first paper read was on Boiler Construction, by Mr. P. Trowern, one of No. 18's most esteemed members, who 64 years ago commenced his apprenticeship in the good old way, for a term of seven years, and is to day still in active service, having charge of the engineering department of the Asylum for the Insane, Toronto. In the course of his paper he said that in the early days many boilers were constructed of copper; this practice later on was abandoned in favor of sheet iron, and then in direct contradiction to modern practice these were handled red hot, and bent to shape in a cast iron mould, hardwood mallets being used to shape them and bolts used to fasten them after the correct shape had been attained. The speaker pointed out that in those days the ore itself was used

in making the billets from which the sheets were rolled. A short description of the boiler in its development towards its present form was also given. Next he dealt with the development of steam, and showed how it was simply the application of natural law in the mechanical world, referring to the Great Engineer in his world system of evaporation. Tables from both Old Country and United States authorities were given, showing comparative tests of bursting pressure of boiler plates. Riveting of plates was also dealt with in an interesting manner. Boiler compounds, blow-off cocks, checks and other boiler accessories, each were given attention. The subject of grate bars being added to above list. The paper was discussed by E. J. Philip and A. M. Wickens, and it was moved by H. E. Terry, seconded by G. W. Dawson, that the thanks of the C.A.S.E. be tendered to Mr. Trowern for his very interesting historical description. E. J. Philip then gave a short description of the various types of chimneys, and their construction. This paper will appear in next issue.

J. M. Dickson, Doorkeeper C.A.S.E.

Wednesday morning at 9.30 saw the convention in full swing. Clause 6 in the report of Committee on Good of the Order was first tackled. Chas. Moseley, J. M. Dixon, H. E. Terry, G. Mooring and W. Oelschlager upheld the clause, and suggested that a nominal charge be made to each member of the C.A.S.E. to defray expenses of printing and distributing the papers. A. M. Wickens proposed that the distribution be made through the employers of engineers, thus answering a double purpose, and suggested a list of 1,000 owners of steam plants be made out, the preference being given to the employers of the members of C.A.S.E., so as to educate the employers as well as the employees. After W. J. Webb had spoken against the expense connected with above proposition it was decided, on motion of A. M. Wickens, seconded by J. M. Dixon, that the papers be issued as formerly

Clause 7—Resolved, That the month of August will in future be the month in which the annual convention is held, and we are of the opinion that the fixing of the day or days of the month to hold same shall be left to the decision of the executive. Carried unanimously.

Clause 8—Resolved, That the changing of the convention from an annual to a bi annual session would be detrimental to the growth of our society. The reasons are respectfully submitted: First, that the organization will be in the course of time very wide in its influence. Second, that the yearly interchange of ideas is a great help. Third, that a bi-annual meeting would mean a lack of interest that would imperil the life of the association. It was moved in amendment by H. E. Terry and seconded by W. J. Webb, that the above clause be not entertained. The amendment was lost, and the clause carried. At this point the question arose as to whether Brantford had a vote or not. The chair ruled it had, and was sustained by a standing vote.

Clause 9—Resolved, That papers be issued to manufacturers and owners of steam plants. Said papers to deal with such questions for example as "Economy in Fuel," "General Saving effected by the Supervision of a Competent Engineer," etc. We recommend that such papers be gotten up plainly and simply, and in such a general manner that they will impress not only the engineer but the employer through whose hands they pass. We also recommend a grant of $50 to be used in this way.

C. Moseley moved and H. E. Terry seconded, that above clause be not entertained. After two votes had been taken the amendment was lost and the clause carried.

Clause 10—Resolved, That a continued effort be made, both by the association and its individual members to secure such legislation as would be in the best interests of not only the association but the public at large. Carried unanimously.

On motion of J. M. Dixon, seconded by A. Ames, the report as a whole was adopted, and the committee discharged.

Before adjourning the meeting invitations were read from the following concerns asking the delegates to visit their establishments: Toronto Railway Co., Toronto Electric Light Co., Gowans, Kent & Co., and the Toronto Asylum for the Insane. These were referred to the executive for reply.

The following committee was selected to look after legislative matters at the next session of the Ontario Legislature: J. M. Dixon, A. M. Wickens, G. Mooring, J. Huggett, C. Moseley, W. J. Webb and G. W. Dawson.

A special committee to work in conjunction with Toronto No. 1, regarding the opposition shown by the locomotive engineers was appointed, consisting of J. M. Dixon, N. V. Kuhlman, A. Storer, C. Moseley, A. M. Wickens and J. Huggett. The following were detailed to draft replies to the entertainers of the delegates: A. Ames, G. W. Dawson and J. M. Dixon.

The convention then adjourned until 3 p.m. when the election of officers took place with the following result:

President—Geo. C. Mooring (acclamation).
Vice-president—W. Oelschlager.
Secretary—A. M. Wickens (acclamation).
Treasurer—C. Moseley.
Conductor—G. W. Dawson.
Doorkeeper—J. M. Dixon.

Scrutineers of the ballot were W. F. Chapman and P. Trowern. The installation of the new officers proceeded with Past President W. F. Chapman acting, with A. Ames as conductor. J. M. Dixon moved that the executive secretary be granted the sum of $25 as a slight recompense for his services, dwelling on the amount of hard work the secretary had put in during the past year. Retiring President Pettigrew seconded the motion, which was carried unanimously. A letter of congratulation was ordered to be sent the Electrical Association in convention at Kingston. A vote of thanks, proposed by W. F. Chapman, and seconded by J. Huggett, was passed, to the retiring officers, and retiring President Pettigrew conveyed his appreciation of the same. After a few words from the new president, G. C. Mooring, the retiring president was presented with a past-president's jewel.

Geo. W. Davidson, Conductor C.A.S.E.

The next place of convention was decided in favor of Brantford, the invitation being tendered by A. Ames on behalf of Brantford.

"The Press" was thanked on a motion by A. M. Wickens, seconded by J. Huggett. With it were coupled the names of The Canadian Engineer and The Canadian Electrical News. Archibald W. Smith, of The Canadian Engineer, thanked the

association and promised all the assistance they could give to promote the educational interests of the association. A delegation was appointed to wait upon the Canadian Manufacturers' Association then in session in the city, to call their attention to the necessity of their members employing properly qualified engineers. The convention ended with the singing of "God Save the Queen."

ANNUAL DINNER.

Webb's Parlors presented an animated scene when the delegates and their friends assembled for the banquet in the evening. J. J. Huggett was chairman and welcomed them on behalf of the Reception Committee. W. J. Webb, the secretary, read letters of regret from Mayor E. A. Macdonald, who was out of town; John F. Ellis, of the Canadian Manufacturers' Association, who was busy with his association; John R. Barber, Hon. F. R. Latchford, H. H. Carscallen, M.P.P., and others. An excellent menu was provided, and after justice had been done to same, Thos. Crawford, M.P.P., replied to the toast, "Ontario the Garden of Canada." His speech showed conclusively that he had the legislative part of the C.A.S.E. very much at heart. He introduced the first bill for their benefit three years ago, and although it did not become law, he was sure a strong impression had been made in their favor, and advised perseverance and a further presentment of the same bill as amended at next session. He paid a tribute to his colleagues in the House, and said that Ontario's public men were entirely influenced with a desire to serve the people, and he believed that if the people understood the extreme necessity of the measure asked by the C.A.S.E. it would not be long in passing the House. So far as he himself was concerned, he firmly believed that the safety of the general public demanded such protection, for it was a case where life and property were at stake. He praised the special committee sent by the C.A.S.E. as a delegation to urge their case. Touching the subject of the toast he spoke of Ontario's wealth, advancement in the manufacturing and other lines, and then asked to make way for the other speakers. A song from W. J. Lawrence called forth an enthusiastic encore, and the next toast of "Toronto the Queen City" was responded to by Ald. Urquhart and Ald. Graham, both of whom spoke from a civic standpoint of welcome to the delegates, and an endorsement of their aims in regard to producing a higher class of men by education. H. Vicars Short then favored the company with an old time nautical song called "Skipper." "The Executive Council" was represented by G. C. Mooring, C. Moseley and E. J. Philip. The remarks of the last speaker touched upon a phase of the legislation which threw light on opposition from certain quarters. Many to his knowledge had expressed themselves against the granting of legislation because it meant higher wages to their employees. Such had not been true in the case of the marine engineer, who has to pass a government examination, and would not be so in our case. The passing of the bill would benefit the manufacturer or steam user in many ways. With an engineer who had passed a proper examination the steam plant would be kept in good order, it would be run economically, and public safety would be assured. A poor man on the other hand could not properly take care of the engines and boilers and would waste more coal than would pay the difference between his wages and what an engineer possessing a certificate would ask. He knew that it was more by good luck than by good management that many boilers in the city of Toronto had not exploded before to-day. In conclusion he said he would be followed later on in the evening by a gentleman who could from daily experience back up all the assertions made by him; he referred to J. J. Main, of the Heine Boiler Co. A comic song by Eddie Piggott preceded the toast of "Our Guests," which was replied to by Messrs. Steeper, of Dresden; W. Oelschlager, of Berlin, and R. J. Pettigrew, of Hamilton. "Our Rights and Wrongs" were treated in a serious vein by A. M. Wickens, and in a comical one by J. M. Dixon. J. J. Main was the next speaker. He regretted that the parties he wished most particularly to impress had, owing to the lateness of the hour, been called away. He referred to Messrs Crawford, Urquhart and Graham, who represented our provincial and civic government. He could from actual experience tell them of steam plants practically left to themselves, no one responsible in charge, and not far from the building in which he spoke. In this particular case he was told if anything went wrong with the boiler (referred to as a furnace in their establishment), a plumber was sent for. On one occasion a plumber could not locate the trouble and the speaker was asked to call and see them. He found the cause of the trouble was that a manhole had been covered over by the bricklayers. They had run this boiler at 40 pounds of steam, and it was a miracle it had not blown up. Over 100 girls were employed in the establishment, and if it had resulted in an explosion the loss of life would have been appalling; and this one case proved that legislation was needed of a controlling nature. Other cities had laws, why was Toronto without them? He earnestly appealed to the audience to put forth their best efforts to secure legislation. With a few remarks from J. J. Huggett, A. Ames, J. M. Dixon and a song from W. G. Blackgrove (by request), the banquet concluded.

NOTES.

The president of the O'Keefe Brewing Co. presented the visitors with a silver-plated match-box as a souvenir of their visit to the works.

Retiring President Pettigrew was far from being a well man during the convention.

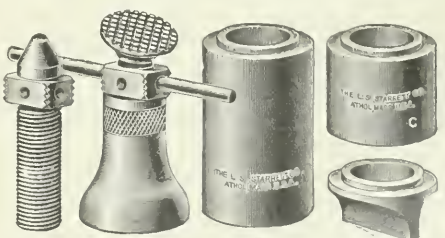
J. M. Dixon repudiated the title of the "Great Irish orator," which was given him by several of the speakers at the banquet.

Jenkins Bros., the well-known valve manufacturers, of Boston and New York, wired their congratulations to the Association upon its work, and gave an earnest of their sympathy by forwarding a cheque for $20.

A. M. Wickens, secretary of the C.A.S.E., is issuing a circular letter to proprietors of manufacturing plants, calling their attention to the fact that the aims of the association are purely educational, and that it is not in any sense a labor organization. Along with the letter is a sample of the educational papers now being issued free for the instruction of steam engineers, and the recipient is requested to commend the work to his engineer. The idea is a good one, and employers will thus have a chance not only to benefit their engineers without cost to themselves, but will have their minds opened to the high claims of the association upon their sympathies.

LITTLE GIANT JACK SCREWS.

These are designed for tool-room use, for leveling up work on a planer-bed or under an upright drill, setting up machinery, etc. All parts are case-hardened. The jack A is 1¼-inch diameter at the base and has a range from 2½ to 3⅝ inches. It will raise 1,000 pounds or more. Two extension bases (B and C), are made to fit the base of the main part A, and are 2 and 1 inch high respectively. With these two extensions used singly or together a reach from 2½ to 6½ inches may be obtained. An auxiliary pointed screw, D, is supplied to be used in place of the screw with swivel cap in certain places where it may be preferable. The base, E, is also provided, for use in cases where such a shape may be desirable. A smaller size is made, 1-inch diameter. Part A, 1¼-inch high; B, 1-inch; and C, ½-inch. With this size, adjustments from 1½ to 3½ inches are obtainable.



The above is one of the many new lines added to the stock of D. Drysdale, of 645 Craig street, Montreal, and one interested can always secure an up-to-date catalogue by sending the firm their address on a postcard.

The T. H. & B. Ry. is raising a portion of its track in Brantford three feet, so as to aid in the flood prevention works the city is now carrying on.

CONDITIONS AFFECTING THE WAVE FORM OF ALTERNATORS.*

BY L. A. HERDT AND E. M. ARCHIBALD.

In what is given below it is not intended to consider the question of wave form as affecting successful distribution, but rather the extent to which the E.M.F. wave of certain machines may change under not unusual commercial conditions. In alternator specification, along with regulation, heating and other clauses, it is often argued that a clause

PLATE 1.

relating to wave form should be included, but as comparatively little is known of the extent to which the wave forms of modern alternators change with amount and character of load—to say nothing of the effect of such changes on the operation of the receiving machinery—it seems advisable that more information be accumulated before very rigid wave form requirements are inserted. However, with a view of throwing more light on the subject, a series of experiments were undertaken in the electrical engineering laboratories of McGill University during the past winter, and though not complete, certain results already obtained may be of interest.

For the purpose in hand a number of different types of alternators were available, some with a concentrated armature winding, and some with distributed windings of the revolving armature, revolving field and inductor types. The E.M.F. waves were obtained from each at different field excitations, different armature currents and different power factors, lagging and leading. The distribution of induction in the air

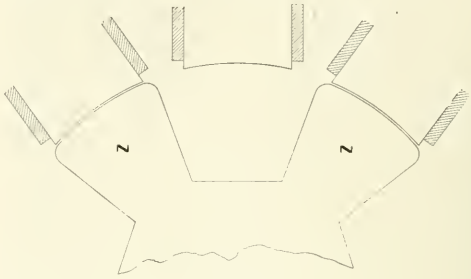


PLATE 2.

gaps under different conditions was also obtained by means of small test coils suitably placed. As illustrating the general effect of lagging and leading armature currents in relation to type of machine upon induction distribution and consequent wave form, the results obtained upon a revolving field distributed winding alternator, part of the magnetic circuit of which is shown in Fig. 1, Plate 1, and upon an inductor type machine with a concentrated winding and poorly shaped inductor lug, shown in Plate 2, may be cited. In Fig. 2, Plate

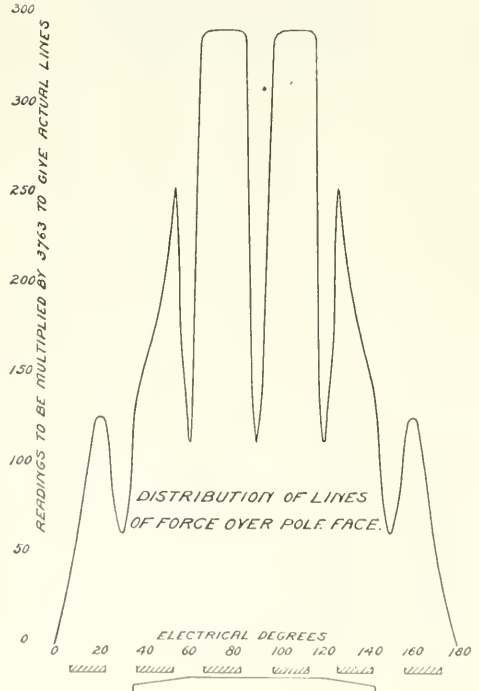


PLATE 1

FIG 2.

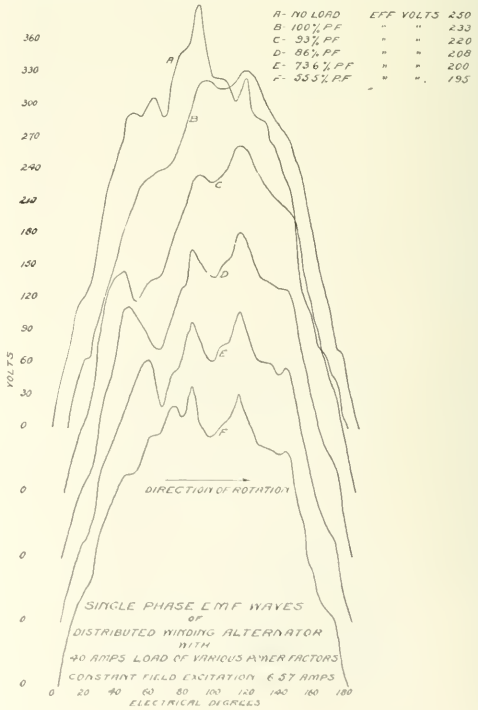


PLATE 3.

1, is seen the distribution of induction in the air gap of the first machine for the particular position of the field pole shown. As might have been expected, the larger part of the induction enters the armature through the teeth, but about one third, in the case of those teeth immediately opposite the

*Paper read before the Canadian Electrical Association.

pole, passes into the armature by way of the slot due to the practical saturation of these teeth. The no load E.M.F. wave

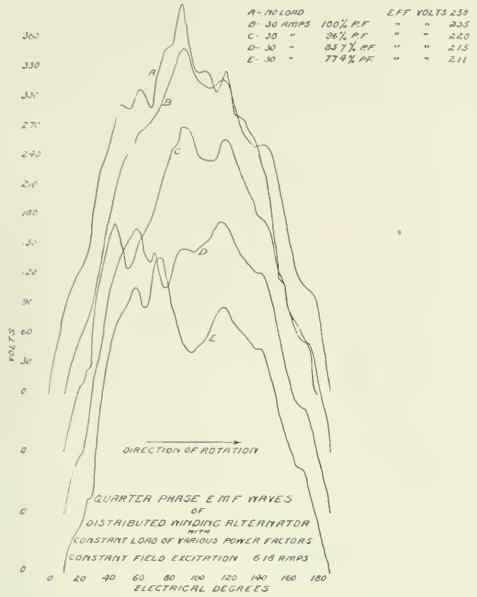

A- NO LOAD EFF VOLTS 250
B- 30 AMPS 100% P.F " " 235
C- 30 " 96% P.F " " 220
D- 30 " 85% P.F " " 215
E- 30 " 77.4% P.F " " 211
VOLTS
DIRECTION OF ROTATION
QUARTER PHASE E.M.F. WAVES
OF
DISTRIBUTED WINDING ALTERNATOR
WITH
CONSTANT LOAD OF VARIOUS POWER FACTORS
CONSTANT FIELD EXCITATION 6.18 AMPS
ELECTRICAL DEGREES

PLATE 4.

of each coil of the distributed winding may be constructed from the no load induction distribution curve by the method

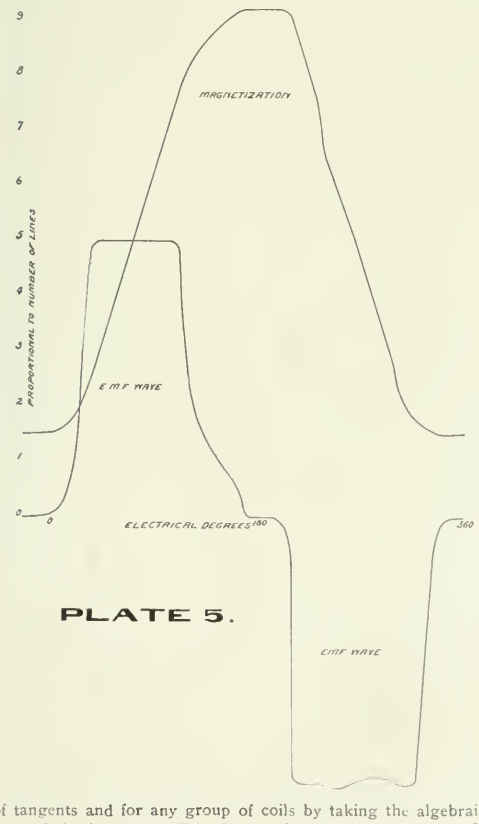


PLATE 5.

of tangents and for any group of coils by taking the algebraic sum of the instaneous E.M.F's. of the individual coils This has been done and the results found to check quite well with experimental values. Plate 3 gives a series of E.M.F. waves for this machine connected as a single phase alternator at no load and full current load of different power factors, lagging currents; the field excitation being kept constant. Plate 4 shows the E.M.F. waves of the same machine connected as a quarter phase generator under similar conditions. It is to be noted that while the

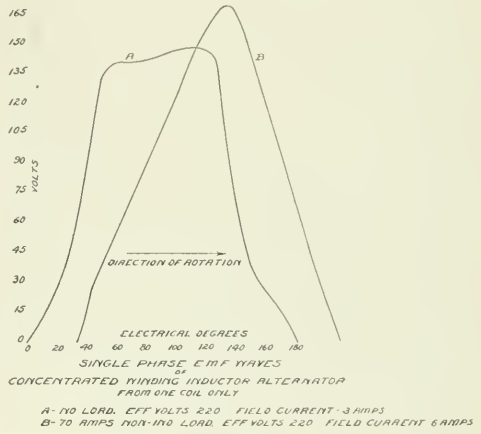

VOLTS
DIRECTION OF ROTATION
ELECTRICAL DEGREES
SINGLE PHASE E.M.F. WAVES
OF
CONCENTRATED WINDING INDUCTOR ALTERNATOR
FROM ONE COIL ONLY
A- NO LOAD. EFF VOLTS 220 FIELD CURRENT 3 AMPS
B- 70 AMPS NON-IND LOAD. EFF VOLTS 220 FIELD CURRENT 6 AMPS

PLATE 6.

wave form and terminal volts both change in a marked degree with power factor, the change is not nearly so great as in the case of the second machine having a concentrated winding and comparatively weak field.

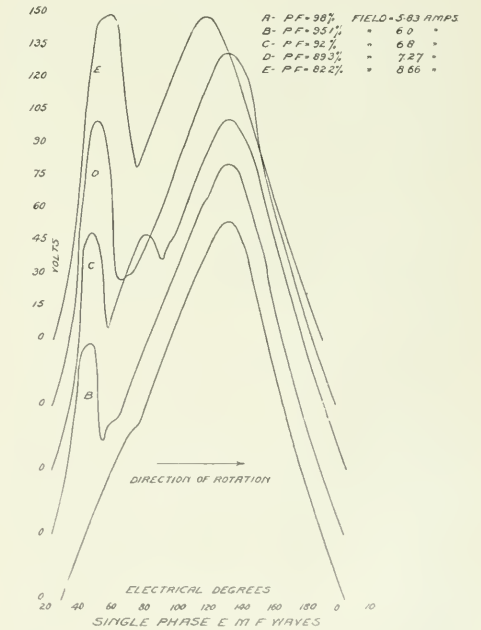

A- P.F.=98% FIELD=5.83 AMPS
B- P.F.=95% " 6.0 "
C- P.F.=92% " 6.8 "
D- P.F.=89% " 7.27 "
E- P.F.=82% " 8.66 "
VOLTS
DIRECTION OF ROTATION
ELECTRICAL DEGREES
SINGLE PHASE E.M.F. WAVES
OF
CONCENTRATED WINDING INDUCTOR ALTERNATOR
WITH
60 AMPS LAGGING CURRENT AT VARIOUS POWER FACTORS
FROM ONE COIL ONLY
TO OBTAIN GENERATOR VOLTAGE MULTIPLY BY 2
EFF. E.M.F. CONSTANT AT 220 VOLTS

PLATE 7.

With a concentrated winding the conditions are different, the wave form not being a function of the angular displacement of the armature coils. In Plate 5 is given the no load induction distribution in machine No. 2 at normal field excita-

tion. It is to be noted that, due to poor design, the armature induction at minimum points is a considerable fraction of its minimum value, which would not be the case in rightly proportioned machines of this type. With this machine also the no load wave form was readily predetermined from the curve of induction distribution and found to agree with the experimental values. In Plate 6 is shown the no load and load E.M.F. waves at different power factors. The change of wave form with character of load is, to say the least, startling, especially to those who have been accustomed to regard the sine wave assumption as to alternating E.M.F.'s sufficiently near for practical purposes. The effect upon the operation of synchronous and induction machinery designed for sinusoidal E.M.F.'s of such waves as shown can be pretty well anticipated. Several synchronous motors were in turn operated from a generator whose wave form was made to vary by changing the character of an auxiliary load. In every case, as might be expected, the energy absorbed and the idle current to the motor increased with dissimilarity of wave. Also the tendency to fall out of step with slight provocation was very marked when the wave shapes were greatly different, but as above indicated, such experiments are not yet complete. It is hoped, however, that enough has been said to induce a discussion of this certainly important subject, particularly from the standpoint of the purchaser and operator of alternating current apparatus.

We desire to acknowledge our indebtedness to Prof. R. B. Owens for the suggestion of the work carried out and for valuable assistance.

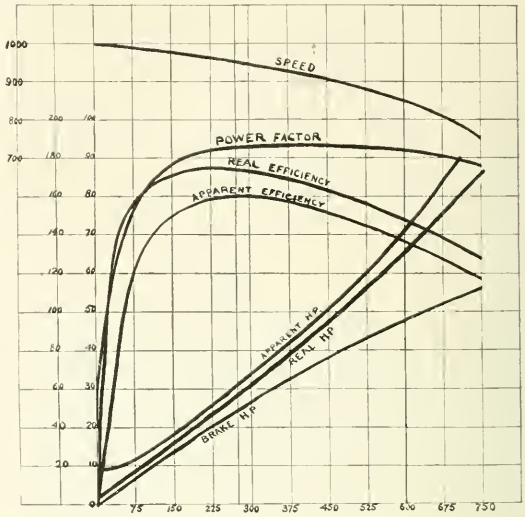
POWER FACTOR AS AFFECTING OPERATION AND INVESTMENT, WITH SPECIAL REFERENCE TO INDUCTION MOTORS AND ENCLOSED ARC LAMPS.*

BY F. H. LEONARD, JR.

Power factor is the ratio of the true watts, to the apparent volt amperes in an alternating current conductor, circuit or device (Houston). In a direct current circuit the energy is calculated by multiplying the volts by the amperes, and the result is the true energy in the circuit in watts, but in alternating current circuits this does not follow, as the electromotive force wave is out of phase with the current wave in every case except when the load is purely non-inductive, as with a load consisting of incandescent lamps only. When arc lamps or induction motors are used, there is always a lagging phase displacement of the current, and when synchronous motors are used, there is also a phase displacement of the current which may be either leading or lagging behind the electromotive force wave, and both conditions may occur, in the case of the generator being driven by a steam engine, twice in each revolution.

With water power, a steam turbine or other prime mover where the angular velocity can be maintained practically uniform and where speed variations affecting the generator take place gradually in a period covering several revolutions of the generator, much better results can be obtained with synchronous motors, always of course presuming that the motor is designed to, and does in practice, give the same electromotive force wave as that produced in the generator, which for reasons which have been at length discussed by many able authors should be a sine curve. Power factor is comparatively a new term to the central station manager, and in fact, was hardly ever heard of before the introduction of the A. C. motor, though some central station superintendents had noticed that there was considerable current flowing in their primary circuits when all their transformers were running with open secondary circuit, and that this current did not take the energy from the steam engines corresponding with the volt ampere readings. To express this condition the terms false currents or wattless currents were used

The transformer when very lightly loaded or when running with open secondary takes much more apparent energy from the circuit than the real energy, because of the lag or phase displacement of the current wave. This displacement, however, grows constantly less as the load is increased, until the E.M.F. and current waves nearly coincide. To illustrate this graphically, the two diagrams of E.M.F. and current waves in a transformer in open circuit and under full load show that the instantaneous values of the product of volts and amperes must be less than the apparent watts, and must be multiplied by the power factor to represent the true energy. As will be noted, the maximum E.M.F. occurs before the current has reached its maximum point. Referring to the full load



PERFORMANCE CURVES—50 H P. INDUCTION MOTOR.

curve it will be seen that current and E.M.F. curves have nearly reached conditions where they increase and decrease together. The nearer this condition is approached, the nearer the power factor approaches unity or 100% power factor. As an induction motor is practically the same as a transformer with one of its elements in motion, its action with regard to power factor may be traced in the same manner, as explained in connection with a transformer.

The primary circuit furnishing the magnetizing current or field and also the work current by induction to the secondary, when running light generates a counter E.M.F. so high that only enough current is taken in the secondary to overcome the friction of the bearings. As load is added the speed is slightly reduced, the slip resulting in lowering the counter E.M.F. until enough current is allowed to flow to do the added work. A very slight reduction in speed is sufficient to reduce the counter E.M.F. of the secondary of the motor varying not to exceed 5% in speed from light to full load and usually not over 2% over the working range of load usually met with. These motors are self-starting from the A.C. lines, and with suitable starting devices take about full load current for a few seconds in coming up to speed light, or a little more than full current in bringing up to speed their normal load, a somewhat longer time being occupied in reaching full speed, depending on the inertia and friction characteristics of the work. If you will consider the counter E.M.F. of the motor secondary as the equivalent of resistance of the transformer secondary the similarity of action will be more striking. The synchronous motor differs from the induction motor from the fact that it does not make its own field, which is usually excited from a separate source of direct current, and it is not usually capable of starting itself even without load, but must be brought up to synchronous speed by means outside of itself. A small induction motor is generally supplied for the purpose, which is disconnected after the synchronous motor has been brought up to speed. The load is then applied gradually with a friction clutch coupling, friction pulley or equivalent device. Once in step, the synchronous motor cannot vary in speed, except the generator driving it changes speed, any more than though the two were positively coupled or mechanically geared together, except by overload much beyond the capacity of the motor, which breaks it out of step as though the gear were broken.

*Paper read before the Canadian Electrical Association.

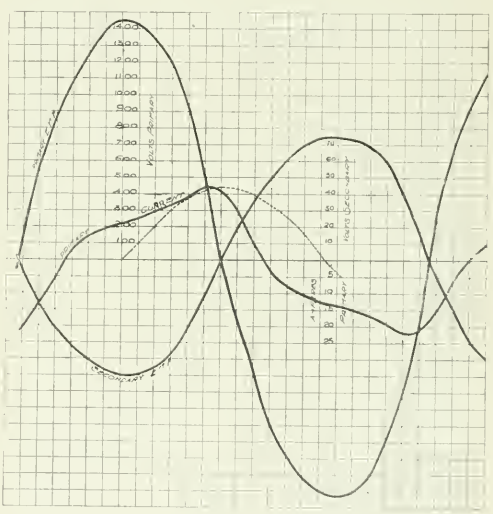
and having fallen below speed even for a fraction of a second, it cannot recover, but will stall, in the meantime absorbing excessive current unless the circuit is immediately opened. The load must then be thrown off and the motor started again as at first. The fact that the synchronous motor has a separately excited field is an advantage under certain conditions as pointed out in my paper before the National Electric Light Association at the New York meeting in 1895. By increasing the field excitation sufficiently in a synchronous motor the apparent paradox of a counter E.M.F. higher than the line or impressed E.M.F. is produced by the motor sufficient to raise the E.M.F. of the line, overcoming all drop, and even altering the pressure at the generator itself, at the same time introducing leading currents having a condenser effect on the line which may be made to balance out the lagging currents produced by induction motors, arc lamps, etc. If this leading phase displacement can be made equal to the lagging phase displacement of other devices, a power factor of unity would result, as suggested by an eminent engineer, though in practice, during a period covering the whole history of this branch of the art, I have never met such a condition, nor have any of my friends in the profession, many of whom have had extensive experience with synchronous and induction motors separately and both together on the same circuits.

An over-excited synchronous motor in the right place, with a load not subject to sudden variations and in charge of an attendant in communication with and controlled by the central station chief, is a convenient means of overcoming line drop and poor power factor. Over-excitation should not be carried too far, as it will result in pumping or flickering the lights. I have a vivid recollection of a case in which a 2½-h.p. self-starting synchronous motor, which I designed, pumped the whole circuit on a 300-k.w. alternator. Under a steady load and careful adjustment of the field excitation, a large synchronous motor supplied with current from a well-designed generator driven by water power or steam turbine, a power factor at full load of .94 or a fraction better may be obtained, though the same motor furnished with current from the same generator driven by a slow speed reciprocating engine, would hardly attain a power factor of .90 at full load, as the fly wheel moment of the motor would make it difficult to follow the changes in angular velocity of the generator, the tendency to break out of step resulting in surges of current, as before intimated.

Generators directly connected to slow speed reciprocating engines, in my opinion, are not suited for operating synchronous motors or rotary converters unless extreme care is taken in designing the fly wheel so as to obtain the minimum change of angular velocity per revolution. A much larger percentage of speed variation taking place more gradually, is less disastrous to the attainment of high power factor.

The best load for a synchronous motor is one of uniformly steady character with no sudden changes in the work it has to do. Throwing the load off suddenly calls for instantaneous adjustment of field excitation in order to prevent sudden rise of E.M.F., which in a large motor would affect the whole line, and even change the voltage of the generator, having a disastrous effect on incandescent lamps that may happen to be in circuit. Suddenly adding a load to a synchronous motor has the reverse result and adjustment of the fields become immediately imperative to prevent heavy drop in E.M.F. A single synchronous motor subject to sudden load variations may easily defeat any attempt at good regulation on the part of the central station management. These objectionable features are minimized, though never wholly overcome by designing both generators and motor for exceptional regulation, using a distributed armature winding with a large number of slots per pole per phase. The old style armature with windings concentrated into a single slot per pole per phase are unsuited on account of their high armature reaction for this class of work.

The induction motor being complete in itself, requiring no exciter, starting motor or clutches, and furthermore, being automatic in its regulation without any special appliances, free from commutators or brushes, is simplicity itself, its essential features consisting of a stationary primary and a rotating secondary in large sizes when well designed has a power factor at full load of .94 or better, regulates well under sudden fluctuations of load without reflecting seriously on the line and generator, but in fact actually tending to assist the regulation of the line. A load thrown suddenly onto an induction motor immediately increases its power factor and helps the regulation of the generator supplying this sudden demand for current. As the power factor of the induction motor is low at light load, it follows that a sudden reduction of the load at once lowers the power factor of the motor, calling for lagging currents in the line, replacing by inductive drop the ohmic drop of the work current of the moment before the armature reactions in the generator tending to demagnetize its field and prevent increased E.M.F., which would otherwise result when load is thrown off. For varying loads and for operating incandescent lamps in connection with a power circuit, under the ordinary commercial conditions, the preference is altogether in favor of a well designed induction motor. With a secondary consisting of copper bars secured to short circulating rings at both ends, insulation is never troublesome, and in fact may be omitted entirely. It rotates without electrical contacts or connections inside the stationary primary element which can be safely insulated for all ordinary voltages, and in the larger sizes connecting the two thousand volts pressure directly to the motor terminals. In the small sizes it is of course advisable to use transformers to reduce the pressure to 500 volts or less where subject to careless handling. Having once become familiar with them, you would never think of using direct current motors with their troublesome commutators, and brushes and expensive repair accounts. Intelligent selection of the size



Transformer Curve over Secondary.

of an induction motor for the work it has to do, has a very important influence on the power factor of the line and it should not run with an average load much below its rated capacity. It is much better to select the motor which, being loaded to its rated capacity, or nearly so, operates with a high power factor and can be overloaded for short intervals to the extent of 25 per cent. of its capacity without doing any harm as there are no delicate parts to this type of machine, nor any moving insulated wires, they will stand a much higher temperature without deterioration than the equivalent direct current motor. Induction motors are also designed for variable speed, many now being used for crane work, and other uses calling for variable speed and torque, but in this class of work they are hardly equal to the direct current series motor, and unless very expensively designed, operate with low efficiency and power factor, though where non inductive resistance is used for control, the power factor may be improved at the expense of efficiency

Arc lamps have been until recently operated from direct current series dynamos, though the first important arc lamp installation used in the city of London, England, the Jablochoff candles as they were called, were operated by alternating cur-

rent dynamos. Several years ago the direct current incandescent companies realized the advantage of being able to supply arc lamps from their incandescent circuits and adopted the D.C. incandescent open arcs. These were soon followed by the enclosed arcs, which operating at a higher voltage admitted of individual control without excessive waste in the large resistance required with the open arcs. Besides this, a great saving was realized in the amount of carbon burned, the inner globes preventing access of oxygen which rapidly disintegrates and causes the carbons to waste away. By no means the least saving which followed was the reduced labor, one man easily trimming six times as many enclosed arcs as he could of the open arcs, as they required attention once in several days instead of daily trimming.

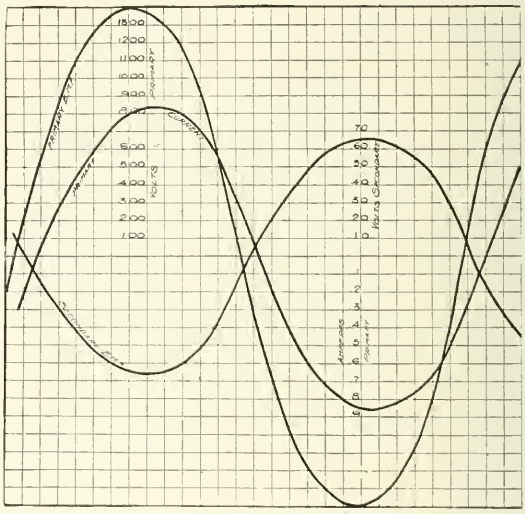
From the D.C. enclosed arc it was but a step to the A.C. enclosed arc with resistance in series, or with Auto transformers or choke coils on commercial A.C. incandescent circuits. It was found, however, that the A.C. arcs operated to reduce the power factor of lines with which they were connected, depending on the regulating device used in connection with them, it being practically impossible to obtain a satisfactory light without some regulating arrangement, though sometimes sufficient choking effect is produced by the feed regulating magnets. All such regulating arrangements reduce the power factor, except the resistance method, but the resistance while improving the power factor wastes true energy and reduces the efficiency, while the inductive regulators only increase the apparent energy or wattless currents. The advantage of operating arc and incandescent lamps from the same dynamo simplifies the central station equipment and admits of the use of a single type of dynamo for all purposes of higher efficiency, interchangeable parts, one type of reserve apparatus, and easier switchboard control. Some of the best inventive talent on the continent has recently been employed upon devices to enable the central station management to rid themselves of the D.C. series arc dynamos, which at best occupy much floor space for their output and have a maximum efficiency of 75 to 80% as against an efficiency of 90 to 97% in large modern A.C. dynamos which occupy the minimum floor space per unit of output at much lower first cost. For A.C. street lighting with lamps in series, one device has followed another till we now have an almost bewildering variety, each device having its superior points, making the choice more difficult.

The constant current transformer operating a string of arcs is almost perfectly automatic provided the load is not too much reduced and can be tapped onto any part of the line to economize wire, the device itself being located in a small substation which may consist of an underground vault, as inspection and adjustment are not frequently necessary. This arrangement has a very fair power factor at full load, but the power factor is low when partly loaded. A device operating on the choke oil principle has all the advantages named in connection with the first arrangement. The amount of choking effect is regulated by the number of lights which is desired to compensate for. If a small percentage of regulation is required, a small regulator at low first cost is sufficient, and at full load the power factor is high, the inductive effect depending almost entirely upon the lamps themselves. Another arrangement has been designed on the principle of the constant potential transformer with loops taken out to automatically vary the voltage as lamps are turned off or on. The power factor is good and rather better at light load than the others, but such a regulator should be kept in the central station, or in a substation when it has the advantage of an intelligent attendant.

Besides devices of the above types, individual transformers may be used, but their high first cost and the fact that each lamp must be turned on and off individually instead of in groups as with the previously mentioned apparatus, makes their use impractical for street lighting except under special circumstances.

In some notable cases where central stations are using power transmitted from a distance, induction or synchronous motors have been coupled direct to D.C. arc dynamos; this would be the ideal place to use a synchronous motor immediately under control of the central station if the induction motor load occurred at the same time, but unfortunately they occur at different periods and we can see no reason for using the synchronous motor as the induction motor is self starting and requires no separate excitation. In any case the motor driven arc dynamos are out of the question except where the frequency is too low for satisfactory arc lighting. Arc lamps are very unsatisfactory on 25 cycles and their effect at least unpleasant unless the frequency is in excess of 35 or 40 cycles. With a mixed lighting and motor load there should be no difficulty in getting a line power factor of .90, and with load consisting mainly of motors .80 to .85. I have in mind a case where about 3,000 h.p., in motors ranging from fan motors to motors of 500 h.p., are used, and recently measurements showed a power factor of about .90, the percentage of incandescent lamps on the circuit being almost negligible.

A power factor of .80 at full load would be disastrous to the regulation of the old style single phase dynamos; no amount of excitation would enable them to hold the voltage on the line. Though many will no doubt recollect seeing at the World's Fair at Chicago in 1893, the then monster two phase dynamos, which were but two large alternators with armature mechanically



Transformer Curves—Full Load.

coupled together so as to give the proper phase displacement to the two independent circuits. Some of our Canadian water power stations who have not yet installed polyphase apparatus having two single phase alternators, might adopt this method of obtaining two phase currents to start a power circuit. With ample water power, the added expense for a day circuit would not amount to much, probably little more than the cost of an additional attendant which would easily be covered by a contract for furnishing power to some manufacturing establishment, or perhaps pumping water for the city and neighboring villages. The power business once started would grow rapidly and become an important source of revenue. Few realize the extent to which the power business is destined to grow. The old style alternator will stand a moderate amount of motor load mixed with lighting load, but when the motor load becomes a large percentage of the total load, the old dynamos which perhaps were admirably adapted for supplying incandescent lights will no longer be suitable. The growth of the motor business has called for radical changes in the design of alternators. Machines which on short circuit would give double full load current were the rule, and this was even urged as a distinct advantage in such an emergency. For motor work, the inherent regulation indicated by a short circuit current of at least three or four times full load current is demanded, and a change of excitation with full load current and .80 p.f. not exceeding 15 or 20% and capacity for 25% more than normal full load current for six hours without dangerous heating, or 50% more than full load current for one hour, which means a very superior dynamo.

This state of perfection having been reached through gradual evolutions resulting from the difficulty of maintaining regulation with motor loads and lagging currents, which tend to demagnetize the fields and lower the voltage, the lagging currents call for increased capacity in the dynamo line and transformers, which supply current to the phase displacing devices, though the power is not increased beyond the small amount necessary to supply the I.R. losses in the copper. This calls for increased investment to cover the first cost of the improved dynamo transformer and added copper, though notwithstanding the advance in raw materials, the very superior dynamos of to-day cost no more than the dynamos of a few years ago, and not so much per k.w. as we were obliged to pay ten years ago for the old single phase dynamos. In all classes of business it is poor policy to attempt to save on the first cost of a plant by buying machinery which is out of date. This is particularly the case in making an investment in electrical apparatus, the design of which has been undergoing such active gymnastics in the past ten years. We must look well into the future and anticipate the growth of the power business, which already bids fair to outstrip the lighting, and get only the best apparatus well up to date in every particular. The apparatus made by the leading electrical manufacturers on intelligent specifications more nearly approaches perfection than any other power translating device, notwithstanding the comparative youth of the art. What engine or water wheel builder would for a moment consider a specification calling for 96% efficiency? Yet electrical manufacturers for the larger sizes of dynamos will guarantee even better than such efficiencies.

With these high attainments it is hard to conceive of any material improvement in electrical apparatus, and we shall probably see little more of the changes once so frequent where entire plants were consigned to the scrap heap because it was cheaper to buy new than to continue even for a short time the operation of the old, the difference being sufficient to turn the balance between success or failure of the enterprise. Already the process of standardization of things electrical has set in, and we may look for changes in the future, tending to a reduction to well recognized standards in construction of apparatus and central station practice rather than to startling improvements in design.

Power factor, which at one time was the great bug-a-boo of the electric central station, is now being rationally met and provided for in the equipment of power houses as a necessary evil, and one of the incidental expenses of a new branch of the business, which adds materially to the income of the plant and enables the hard working manager and superintendent to please his stockholders with increased dividends.

The president thought this one of the best papers submitted to this association. It dealt with matters that central station managers have to consider very seriously, and contains a great deal of interesting matter, both from the standpoint of theory and practice.

E. E. Cary thought the members ought to be allowed to digest these papers over night.

Prof. Herdt, referring to Mr. Leonard's observation that power factor unity with synchronous motor underload is unknown in practice, said that this was not due simply to the difficulty in obtaining a sufficiently large current in the field due to the limited range of exciter voltage and safe working current for field coils.

Mr. Leonard said that at the end of an experience extending over several years in manufacture and experiments, leading up to the manufacture of a single phase, self-starting synchronous motor, he concluded, as intimated in the paper, that over excitation can be carried too far. If a synchronous motor is over excited beyond a certain limit, it begins to make the circuit unstable, and there immediately results a very vigorous pumping and flickering of the lights, which makes the thing utterly impracticable on a commercial circuit. Theoretically it may be otherwise, but in practice there are mechanical and electrical difficulties which enter into the subject that, so far as he has been able to learn, put the thing out of the question entirely. He would like very much to meet somebody that has ever had the experience of obtaining the power factor of unity in motor work. He had talked frequently with many friends who are prominent in the profession, and who have had excellent opportunities to investigate this matter, but up to now he failed to find anybody who has secured this wonderful, or what seemed to him wonderful, result. It is theoretically all right and should be obtained, but in practice it seems to be out of the question.

P. G. Gossler asked if Mr. Leonard did not mean that the power factor of unity is rather an unstable quantity, not that it cannot be secured, because he thought quite a number of people had procured it, though possibly not to be able to make a difference under commercial conditions. The power factor can be made unity, but there is difficulty in maintaining it at unity, because of unstable conditions. In reading the paper over he noticed the statement that the preference is altogether in favor of a well designed induction motor. The usefulness of the induction motor is without question, also the synchronous motor under certain conditions. When under the control of the station it is one of the most valuable adjuncts to the general supply systems now in use, as is well shown in the Buffalo plant, where the power factor is maintained. They maintain it there under their commercial conditions at possibly .97. He did not think there was a claim for the induction motor that it would operate at .97; so that the impression given that the synchronous motor is to be entirely done away with is wrong, because he knew of several other large installations where it is proposed to install synchronous motors. There was another point. Mr. Leonard has compared the action of the induction motor to a transformer, being complete in itself, he says, and automatic in regulation. The impression given there is that there is no regulation required. We know that throwing a load on an empty transformer has a tendency to better the regulation, because it brings the current more nearly in phase in connection with the electro-motive force. Consequently the impression given here that an induction motor is automatic inasmuch as no charge of field excitation is required, is a trifle misleading. There is another question here. Mr. Leonard states that the best load for a synchronous motor is one of a uniform and steady character; also, that the power factor of an induction motor under full load is as high as .94. He (Mr. Gossler), believed that had been obtained. There are very few conditions under which motors, especially when there are a great many of them, use the current under the conditions of full load. Mr. Leonard referred here to a case where about 3,000 h.p. in motors ranging from fan motors to motors of 500 h.p. are used, and recent measurements showed a power factor of about .90. He thought he knew what plant Mr. Leonard had reference to, because he operated it. They found under certain conditions that they had on their line a power factor on commercial loads of .94; removing 25 per cent., the power factor of the entire system fell from .94 to .87 in the capacity of the generator, for certain classes of generator decrease almost as the square of the power factor. If you reduce your power factor from .94 to .87 you have a generator capacity of about .75, or a difference of 13 per cent. That is the deduction from measurements made on their lines in Montreal. Self-starting synchronous motors absorb a large amount of current in starting, very often a full load capacity. The association was very much indebted to Mr. Leonard for that paper. There was one more point. The maximum demand in a station was the time of the overlapping of your office and house lighting—such were the conditions in Montreal. Seven months out of the year that office load laps over the day load, or the time when the induction motors should be in use, that is before 6 o'clock, so that using synchronous motors to operate arc machines, seven months out of the year the arc lights are started prior to 6 o'clock, leaving five months out of the twelve that Mr Leonard's remarks would apply to.

Mr. Leonard did not think he differed so very much from Mr. Gossler on a good many of the points. He (Mr. Leonard) called attention particularly in his paper to the fact that there are places where a synchronous motor can be used to great advantage in overcoming line drop. If you could distribute synchronous motors at certain centres of distribution where your drop is heaviest, and your variation in load the greatest, and you have an attendant there in charge who is under control of the central station, it would certainly serve as a very valuable adjunct to the central station management. You would reduce the amount of copper, and you would re

quire less attention at your switchboard, although that would have to be made up by the attention of the man at the motor, while under those conditions it would be necessary to have the synchronous motor large enough in capacity to take care of the work it has to do as a motor, and besides that have capacity for furnishing leading currents to overcome the lagging currents produced by other induction devices. With regard to power factor, Mr. Gossler in his remarks made a little slip. He said that the induction motors made the power factor higher. He probably meant the reverse. The case that Mr. Gossler mentions was one where they took the two synchronous motors (they only had two on), off their line, and in place they put in all the small induction motors, many of which were running under load. A small induction motor does not give as good a power factor usually as a large one; they improve slightly as the size increases, but a small induction motor with a light load, it is recognized, has a lower power factor; and as stated in the paper, the regulation of the line may be improved by the use of the induction motor. We have at full load a very high power factor. The diagram shown with his paper was taken in actual practice from a moderate sized induction motor, having a capacity of 50 h.p. It starts with a power factor of about 20—at practically no load. It almost instantly reaches 40, and then up to 60, and then rises gradually as the load increases. What he maintained was that the regulation of the line is assisted—though not altogether compensated for—by the use of induction motors rather than synchronous motors. At full load we have a power factor of .93; and we will say at 25% overload we have got very nearly .94; all over this range the power factor is very nearly uniform. He called attention in the paper to the fact that the induction motor should be selected particularly with regard to the amount of work it has to do, so as to obtain the best conditions of power factor. That is, if you have a load of 10 h.p. for five minutes out of the day, and 7 h.p. for the other nine hours and 55 minutes, you should buy, not a 10 h.p. motor to take care of that 5 minutes, but a 7 or 7½ h.p. motor so as to obtain the best conditions. You can stand an overload of 25 per cent.; your power factor is really improved by that load; all over this range your motor is running at good power factor; if there is any slight increase or overload the motor is safe if it is properly designed. If you throw a load off from an induction motor you immediately reduce the power factor. Mr. Gossler said the power factor will vary the electro-motive force something like the square of the variation in the power factor. Under those conditions you have thrown off your load, your generator has lost part of its load; the natural tendency of any generator with fixed excitation would be to increase its electro-motive force; it would immediately, if you throw off a certain amount of load, increase the electro-motive force. With an induction motor having its load thrown off, it brings the power factor down, and in doing so it demagnetizes the field of your current generator and prevents the increase of the field, and lowers the electro-motive force slightly, and compensates, in a measure, for the change of load. He did not mean that this would compensate automatically for every change. You cannot do away with your switchboard attendant entirely, but it assists in the regulation; whereas in a synchronous motor, if a load is off, your voltage immediately rises. You have introduced leading currents, you increase your field strength by the armature reaction, it raises the electro-motive force immediately and will cause trouble with incandescent lights if your attendant is not very sharp with his work.

NEW DRAWING INKS.

Our readers who are engaged in artistic or mechanical drawing know of what great value a good drawing ink is in producing satisfactory work, and how few there are that inspire confidence. The Art Metropole, Toronto, well known as a supply establishment for drawing materials, is introducing from the Mother Country an ink under the names of "Chin Chin" for the black, and "Pelican" for the sixteen colors, which will, it is claimed, afford general satisfaction. The "Chin Chin" is especially adapted for making tracings that require to be reproduced and is said to be the best ink from which to get satisfactory photo-copies (sun-prints). It is water-proof against hot or cold water-washes. The "Pelican" colored inks are exceedingly bright and true, as shown by the color-card, which can be had free from the Art Metropole. "Chin-Chin" and "Pelican" are foremost for quality and quantity, as the 25 cent bottles contain 1½ ounces of ink.

CANADIAN ELECTRICAL ASSOCIATION.

The tenth annual convention of the Canadian Electrical Association was held at Kingston, on the 29th, 30th and 31st August, the president, A. A. Dion, in the chair. Among those present were the following:

F. H. Leonard, jr., John A. Burns, W. J. Plews, W. B. Powell, Wm. H. Browne, P. G. Gossler, H. O. Edwards, A. L. Mudge, N. C. Ross, C. Doutre, W. H. Winter, F. W. Fairman, K. B. Thornton, A. G. Grier, R. M. Wilson, Geo. H. Olney, L. A. Herdt, Thomas Rogers, D. Sleeth, Ed. Brown, J. P. Thomson, R. E. T. Pringle, R. S. Kelsch and A. C. McDonald, Montreal; A. A. Dion, W. G. Bradley, Wm. Ahearn, jr., J. M. Leamy, W. S. Hodgins and D. R. Street, Ottawa, Ont.; W. H. Warrington, A. M. Wickens, T. F. Dryden, J. A. Kammerer, A. C. McDonald, J. J. Wright, H. Gearing, A. B. Smith, J. Raymond, E. B. Biggar and C. H. Mortimer, Toronto; H. R. Leyden, Gordon J. Henderson, F. W. Martin, Wm. A. Turbayne, Hamilton, Ont.; A. A. Folger, E. Moore, Geo. H. Dickson, J. Halliday, W. F. Simmons, E. Ashley, R. White, R. Boyd, jr., H. C. Nickle, I. H. Breck and Thomas Donnelly, Kingston; A. L. Breithaupt, Berlin, Ont.; W. W. Williams, and George Shand, Sarnia, Ont.; B. F. Reesor, Lindsay, Ont.; J. F. H. Wyse, Brantford, Ont.; E. E. Cary, and George A. Powell, St. Catharines, Ont.; J. W. Purcell, Walkerville, Ont.; John Yule, Guelph, Ont.; J. E. Bilger, Berlin, Ont.; A. Sangster, Sherbrooke, Que.; D. E. Blair and Edward Slade, Quebec, Que.; L. A. Somers, Halifax, N.S.; P. H. Howe and Geo. M. de Ginther, New York.

After a meeting of the executive the proceedings began by a formal address of welcome to the association by Mayor Minnes and Ald. Donnelly, on behalf of the city, and E. J. B. Pense, on behalf of the Kingston Board of Trade. To these President Dion replied, expressing the appreciation of the association at this hearty reception. No other city had heretofore taken the pains to receive the association that Kingston had.

The president then delivered the annual address in which he welcomed the members to an active share in the proceedings, and said that each convention increased his faith in the society's value, both from the standpoint of business as well as educational interests. He had hoped to greet them in his own city of Ottawa, but the great conflagration of April 28th, which rendered thousands of citizens homeless, and destroyed a great part of the various electrical plants of the capital, prevented this. The value of the friendships formed in this association was exemplified in a touching manner by the many expressions of sympathy, and the generous offers of assistance received from many of his fellow members when the fire occurred. After referring to the heartiness of the association's reception in Kingston, and to the completeness of the arrangements of the local committee under W. F. Simmons, President Dion went on to say:

It is a source of gratification to me that our membership continues to increase, notwithstanding that a considerable number of members drop out of the association every year. We should put forth our best efforts to prevent, if possible, these annual lapses, and we should not rest satisfied until every electrical operating, manufacturing and supply company, firm or individual is represented on the membership roll. In this connection I would submit to your earnest consideration whether it would not be well to introduce in our constitution a feature of company membership such as carried out by the National Electric Light Association of the United States in addition to the ordinary individual memberships. This might be a means of interesting in our work many companies who now take no part in it, although they all receive practical benefit from our labors. You will be pleased to see by the report of the secretary-treasurer that our finances are in a sound and prosperous condition

The revenue up to May 31st last was about $130 in excess of that of the preceding year, and the cash on hand on the same date was about $330, or more than double the amount on hand on the corresponding date last year. You will observe that this is due largely to the low cost to the association of the convention of 1899, as compared with that of 1898. You will have submitted to you the reports of the various standing committees, and you will realize that all the work of the association is not done at the annual conventions. Those members who have freely given of their time and purse on committee work are entitled to the fullest expression of our appreciation and gratitude. The achievements of the Legislation Committee during the past year have been of incalculable value to the members of this association. Through the untiring, timely and well directed efforts of this committee the "Conmee Bill," which was in danger of being ruinously amended, was reaffirmed by the Legislature of Ontario so that this law now bids fair to remain permanently on the Statute books of the province. This is as it should be. No doubt a careful consideration of this measure has convinced our legislators of the justice of its principle, and the wisdom of its provisions. The committee should be continued for the purpose of watching any legislation unjust to electrical interests which may be introduced in our legislatures, and I trust that such calls upon the companies interested which may be required to meet necessary expenses will be promptly and cheerfully met. Let me say to those who contributed to the expenses of this committee during the past years that they have received good and full value for their money. The work has been done efficiently and economically. The report of the Committee on Meter Inspection will show that it also has gained something for electric lighting companies in the reduction of certain inspection fees. With regard to the Committee on Standardization of Accounts I would commend this work to your serious consideration. If companies could agree on some general plan of distributing operating expenses, and would furnish their figures to some committee of this association it would be possible to circulate among the members comparative statements of expenses, omitting names and amounts, and giving percentages only, which would enable managers to test the economy of their management and apply the pruning knife where necessary. If all companies would agree to make their annual reports of revenue and expenses on the same basis, especially as regards interest, depreciation, and charges of that nature, and publish their statements, it would be possible to ascertain the true percentage of net profits in each case, and this would tend to remove from the minds of municipal legislators the impression often prevailing that there are enormous profits in public services such as electric lighting. In this way the ardor of advocates of municipal ownership might be tempered. At any rate it would have an educational value for the ratepayers. The above considerations were suggested to me by a discussion on this subject which I had the privilege of hearing at the recent convention of the N. E. L. Association, who appointed a strong committee to deal with this question. Letters have recently been received by electric light companies in Canada from the National Electric Light Association of the United States, urging such companies to join that association (whose membership fee is $25 per year), in view of the important work being done by it for the benefit of electric light companies. While that association, which has several Canadian companies on its membership roll, is to be commended for the work it is doing, I must remind Canadian electric light companies that their first duty is to the Canadian Electrical Association, whose work is of more immediate value to them, and which is in greater need of their co-operation and support. The committee on papers is to be commended for the high character of the papers to be read and discussed at this meeting, and I desire to tender to the distinguished writers, who have given us so freely of their precious time, the thanks of the association. The range of subjects is such as to, I trust, please every member. It is a matter for congratulation that the electrical industries in Canada generally continue to enjoy a reasonable amount of prosperity. The past year has been marked by extraordinary activity and progress. Many new and extensive electrical works have been carried out, and everywhere there has been evidenced the greatest confidence in the future success of electrical undertakings. Water powers have been developed and utilized, and electric power transmitted to long distances. Large works and factories hitherto operated by steam have adopted the electric motor in large units. Some steam railways have been converted into trolley lines. Electric railways have been extended far out of cities, equipped with heavier rails, better rolling stock, larger generators, and more powerful motors, and higher speeds have prevailed. Electric light and power stations have been enlarged and remodelled. In this particular field there has been a decided tendency to install generators of one kind only, and to supply all services therefrom, hence the increasing use of A. C. polyphase motors of the "induction" or "synchronous" type, and A. C. arc lamps of the enclosed arc variety either "series" or "constant potential." The use of electricity in mining has also received considerable development, and its application to the manufacture of calcium carbide is beginning to assume large proportions. The large number of small central station installations testifies to the increasing popularity of electric lighting and power. New isolated plants, some of them very considerable, were also very numerous. As a central station man I regret this, but I suppose the manufacturer is happy. In the telegraph and telephone fields the past year has witnessed important extensions and improvements to existing systems.

Among the many important works of the year the following may be mentioned: The great water power and electrical developments at Shawinigan Falls, and other places on the River St. Maurice, Que.; the Jacques Cartier Water & Power Co., transmitting energy from the falls of the Jacques Cartier River to the city of Quebec for general light and power distribution; the Canadian Electric Light & Power Co.'s transmission from the Chaudiere Falls on the river of that name to the town of Levis, Que., for general distribution, with possible future extension to the city of Quebec, opposite, through submarine cables; the Lunenburg Gas Co., transmitting 100 h.p. 8 miles, for distribution in Lunenburg, N.S.; the 14-mile power transmission of the Lindsay Heat & Power Co. into Lindsay, Ont., recently inaugurated; extensions of the Metropolitan Ry. of Toronto to Newmarket, 30 miles distant. Extensions of the Ottawa Electric Ry. to Britannia on the bay, and to the Dominion rifle ranges; the conversion of the steam railway from Quebec to Ste. Anne de Beaupre, some 30 miles; the adoption by the Montreal Street Ry. Co. of electric power from Chambly, Que.; the installation of several thousand h.p. of induction motors by the Dominion Cotton Co., for their mills in Montreal, and by other factories in the same place; the installation by the E. B. Eddy Co., of Hull, Que., of 1,500 or more h.p. of induction motors, and the building of a power house by Conroy Bros. at Deschenes, Que., five miles away, to supply the power at 10,000 volts; the 500-h.p. plant of the Soulanges canal used for operating the lock gates, and for lighting the canal; the 2,700 h.p. generating water power plant of the Bronsons' Co., at Ottawa, supplying energy for the manufacture of calcium carbide to the Ottawa Carbide Co.; the extension of the Government telegraph system in the Yukon district, 600 miles, and along the north shore of the lower St. Lawrence River for 300 miles down to Labrador; the substitution of storage batteries and dynamos for chemical batteries in the plants of the G.N.W. and C.P.R. telegraph Co.'s at several places; the complete renewal of the Bell Telephone Co.'s plant at Ottawa, introducing the "Central energy" system; the complete reconstruction of their lines there and in other places, and the extension of their long distance system in all directions. To this list, made mostly from memory, many other important works and undertakings could be added. The pleasing features of all these undertakings, from an engineering point of view, is the generally scientific design and modern character of the apparatus and works.

Mr. Dion concluded by expressing his appreciation of cordial co-operation of various officers, especially mentioning the secretary-treasurer, in the work of the year.

After the reading of the minutes of last meeting, the secretary-treasurer read his annual report, in which he referred to the slight increase in membership during the year. He suggested that means should be taken to induce the various electric companies now outside the association to join and become actively interested in its work. He again referred to the refusal of some members to pay arrears of membership fees, taking the ground that they had only joined for one year. He suggested a change in the form of application by which a member would bind himself to pay the fees until his resignation was tendered and

accepted. The number of members now on the roll is as follows: Active members, 213; associate members, 31; total, 244; a gain of three over last year. Three meetings of the executive had been held during the year. At the first of these Gordon J. Henderson reported the settlement of accounts at the Hamilton convention, the balance above $100 having been defrayed by voluntary contributions. At the second meeting several topics for papers at the next convention were suggested, and an invitation to attend the International Electrical Congress of 1900 at Paris was read. Messrs. Street, Gossler, Higman, Cary and the secretary were appointed a committee on papers for this convention. At the last meeting of the executive, held in Toronto, the secretary was directed to notify members in arrears that their resignation would not be accepted till their indebtedness to the association was discharged.

The following are the receipts and disbursements for the year ending May, 1900, and the same carried down to the date of the convention:

FINANCIAL REPORT FROM JUNE 1ST, 1899, TO MAY 31ST, 1900.

RECEIPTS.

Cash in bank, June 1st, 1899	$137 76
Cash on hand, June 1st, 1899	17 85
194 Active Members' fees at $3	582 00
21 Associate Members' fees at $2	42 00
50 copies convention report	5 00
Exchange on cheque	25
	$784 86

DISBURSEMENTS.

Grant to local committee	$100 00
Geo. Angus, stenographer	26 00
C. R. Lane (assistant to secretary)	3 00
Electrical News, printing account	96 90
Express order	25
Express charges	60
Grant to secretary	125 00
Secretary's travelling expenses to Ottawa attending Executive meetings	31 00
Postage	35 61
Exchange on cheques and drafts	13 38
Express charges	59
Telephone messages and telegrams	2 85
Stationery and printing	16 50
Balance	333 18
	$784 86
Balance in Bank, May 31st, 1900	$339 83
Balance on hand, May 31st, 1900	11 20
	$351 03
Unpaid accounts	17 85
	$333 18

SUPPLEMENTARY STATEMENT.

RECEIPTS.

Money on hand, June 1st, 1900	$ 11 20
Money in bank, June 1st, 1900	339 83
25 Active Members' fees at $3	75 00
4 Associate Members' fees at $2	8 00
Envelopes used by Legislation Committee	1 00

DISBURSEMENTS.

Convention buttons	$ 6 25
Telegrams	1 83
Postage	15 00
Exchange on drafts	90
Ribbon for badges	1 11
Stationery	60
Money on hand, August 27th, 1900	17 01
Money in bank, August 27th, 1900	302 33
	$135 03

The report was adopted.

E. E. Cary, J. J. Wright and J. F. H. Wyse were appointed nominating committee for the election of officers for the ensuing year.

At the afternoon session it was announced that owing to the death of his sister on the 23rd August, Prof. Owens was obliged to leave for the United States, and could not prepare the paper down in his name.

L. A. Herdt, assistant professor of electricity at McGill University, then read the paper on "Conditions Affecting the Wave Form of Alternators," prepared by himself and E. M. Archibald. It will be found elsewhere. He was complimented by the president on the paper, as one showing great original research and patient labor, and as presenting results that were startling. This was followed by the valuable paper by F. H. Leonard, jr., of Montreal, on the "Power Factor as affecting Operation and Investment, with special reference to Induction Motors and Enclosed Arc Lamps," which will be found elsewhere along with a summary of the discussion which it elicited. "Some Experiments with Rotary Converters," was the title of an instructive paper by A. G. Grier, B.Sc., and J. C. Hyde, B.Sc., which is held over till next issue.

After adjournment the members gathered at Folger's wharf in the evening, where the steamer "American," kindly chartered for them at the city's expense, was waiting to take them down the St. Lawrence among the Thousand Islands. A searchlight was in operation to give the visitors a better view of the picturesque scenes. The mayor and a number of aldermen and citizens were present, and besides refreshments excellent music was provided by the 14th Battalion band, aided by a negro minstrel. But the minstrel did not provide more fun than did Messrs. Cary, Leonard, Pringle and Gossler, along with a number of jolly Kingstonians whose cake walks and dances left the spectators with sore sides by the time the steamer returned to the wharf, which was about midnight.

THURSDAY.

On opening the morning session the president asked what action the association intended to take upon the question of company membership.

J. J. Wright said it was necessary to get a better organization than that now existing, so as to enable electric light companies to defend themselves from attempts at confiscatory legislation.

H. R. Leyden thought the association was gradually drifting away from its original purpose, which was that of an association of electrical engineers, but was becoming one that existed for the benefit of the companies and supported by them.

The president said the purpose of the change he proposed was to enable a company paying a "company fee" to send any individual they wished to represent them at a convention. As the constitution now stood, if a company wished to change a man other than the one already entered as their representative they had to pay a fresh fee.

P. G. Gossler did not like the idea of working away from the primary design of the association as a society of electrical engineers.

E. E. Cary thought that the commercial and scientific interests of the association could work side by side. In the United States exhibits of electrical appliances were an interesting feature of the conventions, and these exhibits were largely made, not for the sake of any business that would come directly from them, but to obtain the criticism and suggestions of members towards improving upon the appliances shown, though to be sure these criticisms were for the advantage of the firms exhibiting. The present was the first year in Canada when exhibits were allowed, under the auspices of the association. His own firm had taken advantage of it, and he was sure others would in future years, to the great advantage of members who came to see what new ideas were coming up.

John Yule thought the country was not large enough to run an association on the lines of that in the United States, which had an institution limited to electrical engineers. Here we would have to combine all interests to form a strong association. He moved that the matter be referred to the Executive Committee for report. This was seconded by A. B. Smith.

H. O. Edwards suggested that in a company membership

the fees should be fixed according to the number of representatives a company had.

Messrs. Leyden and Doutre thought it would be hard to decide on an equitable fee on a sliding scale. After further discussion Mr. Yule's motion was carried.

On motion of B. F. Reesor it was decided that the forms of membership should be altered in accordance with the recommendation of the secretary-treasurer.

P. G. Gossler wished to give notice of motion that the necessary steps be taken to have the company membership plan inaugurated at the next convention.

On behalf of the committee on statistics, J. A. Kammerer, chairman, reported by letter, that although a lot of data had been gathered they had not been able to arrange and tabulate it, and asked that the committee be continued. He at the same time asked to be relieved from the chairmanship as the pressure of business was so great upon his time that he could not do justice to this important work. The report was adopted.

The Committee on Meter Inspection (A. A. Dion, chairman), reported that since the last meeting of the association they had interviewed the officers of the electrical inspection branch of the Inland Revenue Department to ascertain if the working of the Inspection Act could not be made easier to the electric light companies and less expensive. They obtained the following concession: Whenever a meter requires inspection before the expiration of the five years covered by the last regular inspection it shall be certified by the department for a fee of 50 cents only, instead of the regular fee. This, while effecting a saving to the companies shows the desire of the department to meet the electrical companies half way. The report was adopted.

The Committee on Legislation (J. J. Wright, chairman), referred to the attempts made in the Ontario Legislature to practically repeal the Conmee Act by means of an ingeniously worded bill proposed by Mr. Graham. An appeal for means to fight this measure was made to the lighting companies and $400 raised, but postponements and amendments in Parliament necessitated an outlay of $827.78, which was nearly all met since by additional subscriptions this year, but there is still a deficit of $32.86. Though the principles of the Conmee Act are now more firmly established than ever there will probably be further attempts to stultify it at future sessions. As many companies not connected with electric lighting have benefited, and will continue to benefit by the bill it was hoped they would assume a fair share of the burdens of defending their just interests. If every company benefited did so the cost for each would be only nominal. Already this year several companies had been saved from confiscation by the Conmee Act, while at the same time the interests of the municipalities have been equally protected. The names of 76 companies and individuals were given as contributors to the defence fund.

Mr. Wright thought that there should be a more equitable division of expenses in connection with the work of this committee than by the present peremptory mode. Something should be done in line with the president's recommendations.

Wm. Williams thought that many gas companies would be glad to contribute, as their interests were identical in the matter of legislation.

John Yule thought that a canvasser could be sent out to get the companies to contribute a specific amount for five years. He moved, seconded by Wm. Williams, that the matter be referred to the Executive Committee to develop the plan. Carried.

On motion of P. G. Gossler, seconded by A. B. Smith, the committee appointed to confer with the Underwriters, regarding the wiring regulations of Montreal, was continued.

D. R. Street in the absence of Mr. Hart, the chairman, reported for the committee appointed to formulate a standard system of central station accounting, and stated some progress had been made, but not sufficient to submit a complete system. Forms had been received from T. E. Oakley, of Fort William, and the Librarian of McGill College offered to allow the committee to use a paper on central station accounts, presented at the meeting of the National Electric Light Association in Montreal eight years ago. A paper by Mr. Colquhoun at the last meeting of the same association was also available. On motion of A. L. Breithaupt, seconded by J. J. Wright, the committee was continued.

The committee for defining the standard of arc lamps also reported its work unfinished. The president said there were so many different kinds of arc lamps now in use that it was difficult to reach a standard, and he thought such a question should be left in the hands of the larger electrical associations in England and the United States. The committee was continued

The personnel of the various standing committees referred to is as follows for the ensuing year:

Committee on Statistics—J. F. H. Wyse, J. A. Kammerer and A. A. Wright, of Renfrew.

Committee on Legislation—R. O. McCullough, Galt; J. J Wright, B. F. Reesor, C. B. Hunt, John Yule, H. R. Leyden and A. L. Breithaupt, with power to add to their number.

Committee to confer with Underwriters re wiring—P. G. Gossler, Edw. Slade, A. A. Dion, Geo. W. Sadler and A. Sangster.

Committee on Rating of Arc Lamps—O. Higman, P. G. Gossler, Fred. Thomson, John Yule and J. F. H. Wyse.

Committee on Meter Inspection—A. A. Dion, E. E. Cary and J. J. Wright.

Committee on Standardization of Accounts—P. H. Hart, D. R. Street and A. A. Wright.

On motion of A. B. Smith, seconded by H. R. Leyden, the usual grant of $125 was made to the secretary.

The paper by W. J. Camp on the "Use of the Dynamo and Storage Battery in Telegraph Offices" was then read. It will be referred to in another number.

The discussion was then resumed on Mr. Leonard's paper, during which Mr. Leyden was asked as to the operation of induction motors and enclosed arc lamps in Hamilton. He said they had proved to be all they were expected as far as economy was concerned. As to the enclosed arc lamps they saved considerable power as well as expense in trimming and carbons. They had had six months' experience with them. In reply to questions he said that where your power was divided into small units, that is for small motor work, the induction motor was preferable. Where the motors are large and the loads steady the synchronous motor should be used. As to the lamps it had been said that the enclosed arcs did not give so much light; but he maintained that they gave a more efficient light, for while it was not so intense just under the lamp it was better diffused at a distance, and the fact that it was not so strong immediately under enabled the lamp to be placed down nearer to the street without blinding people.

Mr. Sangster said his company in Sherbrooke was using 90 enclosed arc lamps, with compensating transformers, 80 volts to a lamp; and the lamps were easy to maintain. One carbon lasts two weeks with these lamps. As to the better diffusion of light he agreed with Mr. Leyden.

In the afternoon an early adjournment was made for a daylight trip down the river, and an inspection of the Kingston Penitentiary and Insane Asylum. A large number availed themselves of the trip and combined business with pleasure by asking Mr. Blair to read his valuable paper—printed elsewhere—on the Quebec Street Railway.

FRIDAY.

The election of officers was the first item on the order of the day and resulted as follows:

President—A. A. Dion.

1st Vice-President—E. E. Cary.

2nd Vice-President—P. G. Gossler.

Secretary-Treasurer—C. H. Mortimer.

Executive Committee—A. B. Smith, O. Higman, D. R. Street, J. J. Wright, B. F. Reesor, W. F. Simmons, W. H. Browne, W. J. Camp, John Yule and Edw. Slade, the last named five being new members. Messrs. Purcell and Reesor acted as scrutineers of the ballot.

On motion of J. F. H. Wyse, seconded by F. H. Leonard, the city of Ottawa was chosen as the next place of meeting.

On motion of J. J. Wright, seconded by J. A. Kammerer, the fixing of the date of the next convention was left to the executive.

On motion of John Yule votes of thanks were passed to the Mayor and City Council, the Board of Trade, the Street Railway Co., the warden of the penitentiary, and others, for their hospitalities during the convention.

J. A. Kammerer having requested John Yule to retire called the attention of the convention to the valuable services

rendered by that gentleman to the electrical interests of Ontario in connection with the Conmee Act, and suggested some formal expression of the association's appreciation of his persistent work. The suggestion was heartily taken up, and on motion of W. H. Browne, seconded by J. J. Wright, the following resolution was adopted and ordered to be engrossed for presentation: "Resolved, That more than a year having elapsed since the inauguration of the legislation procured by the Legislative Committee of this Association, under the guidance and leading of our past president, John Yule, this association, recognizing the great advantages in the element of justice brought to operating companies, feel it incumbent to record its appreciation of the hearty and continuous work of Mr. Yule on behalf on such legislation."

On being recalled and informed of the resolution Mr. Yule modestly disclaimed any personal merit for his work, but said it was satisfactory to know that during the present year at least three companies had been saved by the Conmee Act from confiscation to the amount of hundreds of thousands of dollars. At the same time he advised electric companies not to be too aggressive, but simply to ask for fair play. He cited the case of Picton, Ont., to show that municipal ownership was not what its advocates claimed for it. There they found the estimated cost of the plant so far under the actual needs that they are now raising additional debentures to keep it going.

After votes of thanks to the readers of the papers President Dion gave a hearty invitation to all to attend the next convention, and said that only the consideration of its being held in his own city justified him in accepting the presidency for a second term. The convention then closed.

THE ANNUAL DINNER.

The annual dinner took place at the convention headquarters, the Hotel Frontenac, on the evening of August 30th, and was very much enjoyed. The dinner itself was probably the best in the history of the association, and reflected much credit on Thomas Crate, the proprietor. The chair was occupied by A. A. Dion, the president. After the "Queen" was duly honored, the toast of the "President of the United States" was responded to by Col. Twitchell, for forty years U.S. consul at Kingston, whose eloquent tribute to the advance of electrical science and to the growing sentiment of brotherhood between the Anglo-Saxon peoples was heartily applauded. He urged electricians to go on with their discoveries, for they had already made peace more probable, and would in future dis-

E. E. Cary, Vice-President Canadian Electrical Ass'n

putes make war less likely. The toast of the "Mayor and Corporation," was replied to by Mayor Minnes, Ald. Craig and Ald. Donnelly, the latter gently touching up the electric firms who do the wiring for steamers. Some heavy losses had been sustained by the Underwriters through the bad wiring of vessels. He hoped new rules would be adopted and strictly carried out to prevent this needless loss. As an evidence of what he considered carelessness in the lighting of steamers he mentioned that one of the St. Lawrence boats was lighted with an acetylene gas plant, which he thought should only be used in place that were both cool and dry, which a steamer's hold was not. The Chief of Police was also toasted. "Our Association" was coupled with the name of W. H. Browne, general manager of the Royal Electric Co., who was received with cries of "He's all right," and who made one of the best speeches of the evening. After humorously referring to the genial qualities of the members, he congratulated them on having such a good convention considering that this was such a busy time of the year. He was glad to be able to say that the bad work alluded to by Ald. Donnelly was not performed by any member of this association. The interchanges of thought at these conventions were doing much to realize the high aims of the association, and the papers read at the present convention were far in advance of any hitherto presented. "Allied Interests" were treated in an able manner by M. H. Folger, who gave a double meaning to the phrase by some eloquent and much applauded references to the Anglo-Saxon alliance. He mentioned that the first two men killed in the Cuban war were two brothers from Ontario, while many Americans had given up their lives to maintain British liberty in South Africa. E. E. Cary was toasted, and was received with "He's a jolly good fellow." He referred to a remarkable scene he had witnessed at a banquet at the Fishmongers' Hall in London, when the Earl of Selborne, speaking of British-American relations, said that if King George had had the same feeling for the colonies as Britons now had there would have been no American revolution. The health of Messrs. Simmons and Nickle was drunk as a volunteer toast. "Our Guests" was responded to by J. J. Behan and Ald. Donnelly; the "Press," by E. J. B. Pense, and the "Ladies" by L. W. Shannon. Excellent music was furnished by the 14th Battalion band and by Mr. Cary's orchestra; songs being sung by Messrs. Cook and Craig.

NOTES.

The electrical illumination in the city hall during the convention attracted large crowds every evening. An electric fountain was erected under a booth in the centre of the hall, the whole being lighted by colored lights, and decorated with ferns and flowers. The lamps here were furnished by the Packard Electric Co., of St. Catharines. One of the features was the sign "Packard Lamps" in white lights, and the motto "L'Union fait la Force." Not content with a scene to please the eye, the Packard Co. charmed the ears of the throng by the artistic music of an orchestra whose chief performer was a talented player on a double-headed guitar of 16 strings, combined with a whistle. The company had some regard for the visitors' stomachs also, as lemonade, punch and ice cream was supplied to many of the callers.

The speakers' platform of the hall was decorated very tastefully by I. H. Breck, electrician, of Kingston, who had a large maple leaf and the word "Welcome," also the initials of the association "C. E. A." in colored electric lights of red, white and blue. Over the platform were the words "Fiat Lux" (let there be light), the whole being cleverly arranged.

Mr. Edwards, on behalf of the Royal Electric Company, pleased the members with a handsome souvenir in the shape of a card case and ticket case. A memorandum printed on the celluloid lining of the case states the interesting fact that 117 "S.K.C." generators have been sold, aggregating 38,410 kilowatt capacity.

Munderloh & Co., Montreal, was ably represented by John A. Burns, who decorated the lapels of the members' coats with Union Jacks, and presented them with a convenient metallic pocket match-box. Mr. Burns has a few of these serviceable souvenirs left which he will be pleased to send to any interested persons as long as they last.

J. H. WILLIAMS AND CO.

The well-known manufacturers of drop forgings, J. H. Williams & Co., Brooklyn, N.Y., have recently issued a new catalogue of their special lines, which contains some useful information. This firm has for years manufactured these standard lines of drop forged engineers' and machinists' wrenches, but the socket wrenches have been recently added. This is said to be the only line of drop-forged socket wrenches upon the market. By referring to page 7 of the catalogue you find that these makers were the first to establish a uniform standard line of engineers' wrenches, and that they made the first of these goods with 15° angle, since generally adopted as the best design. The straight tail lathe dogs were made more

especially for export trade, and have been added within the last few months. Bent tail dogs have been made for years. Many of the articles shown are of particular interest to those engaged in the manufacture of automobiles, gas engines, water motors, etc. There are said not to be any competing standard lines of valve stems, and crank shafts for rod ends. There is considerable demand for the Vulcan chair wrench throughout Canada. It is the only wrench adapted to both a cable and a flat link chain.

Industrial Notes.

A steel bridge is to be built across the St. Croix river near St. Stephen, N.B.

The Imperial War Office has recently enquired for portable wooden houses in Canada.

The name of the Toronto and Orillia Stone Quarry Company, Ltd., has been changed to New Longford Stone Co., Ltd.

The Morton Co., Ltd., has been incorporated to take over the business of the Automatic Check Book Co., Toronto; capital stock, $40,000.

The Nova Scotia Carriage Co., Kentville, N.S., will build an addition to its factory. It will be 100 feet long, 20 feet wide and three stories high.

Hourd & Co., Ltd., will make furniture in London, Ont.; share capital, $25,000. The incorporators are E. Hourd, F. G. Rumball and S. H. Hunt, London, Ont.

W. T. Jennings, C.E., who was engaged by the Winnipeg city council to examine the water supply and works of the city, has made his report which we hope to publish next month.

Barrie, Ont., has let contracts for the waterworks extension to Allandale. W. F. Grant & Co., Toronto, do the work; the Canada Foundry Co., Toronto, supply the pipes and castings, and the Kerr Engine Co., Walkerville, Ont., the hydrants and valves.

J. H. K. McCollum, J. B. Perry, R. Lawyer, R. H. Bowes and F. A. Hilton, Toronto, and J. R. Minhinnick, London, Ont., have been incorporated as the McCollum Power-Brake Syndicate, Ltd., capital stock, $40,000; chief place of business, Toronto.

R. Dowling, J. W. Wilson, G. Leighton and R. J. Wells, Harriston, Ont., and G. Fulton, township of Minto, Wellington county, Ont., have been incorporated as the Dowling and Leighton Co., Ltd.; capital stock, $50,000; to make furniture in Harriston, Ont.

J. M. Wallace, J. P. Vrooman, M.D., Margaret Wallace, and T. B. Wallace, Napanee, Ont., and E. J. Roy, Belleville, Ont., have been incorporated as the Dominion Rock Drill and Foundry Co., Ltd.; capital stock, $6,000; to make rock drills and carry on a foundry business in Napanee.

The work of organizing the British American Furniture Co., the purpose of which is to take over some twenty-three Canadian furniture factories, chiefly located in Wellington, Waterloo, Perth and Bruce counties, is about completed. The company will have a capital of $3,000,000.

G. R. Locker, F. B. Locker, J. Ballantyne and F. E. McKeys, Montreal, J. H. Sticht, Foxcroft, Me., U.S., have applied for incorporation as the Dominion Architectural Metal Works Co., Ltd.; capital stock, $8,000, to make metal grill work, electric light and gas fixtures, etc., in Montreal.

The Maritime Hardware Association held its second annual meeting at Digby, N.S., recently, and elected the following officers: President, A. M. Bell, Halifax, vice-president, T. McAvity, St. John; executive, S. Hayward, P. McMichael, W. Kerr, St. John, and E. G. Stairs, W. G. Robertson and W. E. Brine, of Halifax.

Martin & Warnock's grist mill, burned down in the fire at Ottawa, is being rebuilt. The new mill will be of four stories, 80 by 50 feet, and is to cost about $55,000. Besides the flour mill, with a capacity of 200 barrels per day, and an elevator, with a capacity of 100,000 bushels, there is to be an oat meal mill with a daily capacity of 150 barrels.

The people of Kingston will soon be asked to vote on a proposal to raise $50,000 for an arts and science building for Queen's University.

The contract for the Imperial Starch Company's factory at Prescott has been let to Wilson Bros. of Kingston, the amount being about $45,000.

S. G. Dolson is preparing plans for the Ham-Nott Co.'s new bicycle factory at Brantford, which the city has loaned $10,000 and bonused to the extent of an additional $5,000.

W. H. Merritt, Strathroy, Ont., J. G. Hay, A. B. Hay, J. M. Kilbourn, H. B. Smith, Owen Sound, Ont., have been incorporated to make furniture as the National Table Co., Ltd.

John Moravec, of Chatham, N. B., late of the Maritime Sulphite Fibre Co., says he has made arrangements to build a 50-ton pulp mill at a point between Chatham and Sinclair's Bridge.

The General Fire Equipment Co., Ltd., has been incorporated with a capital stock of $40,000 by J. Wright, S. S. Clarke, W. Phillips, D. Carlyle and D. Urquhart, Toronto, to manufacture fire engines, fire extinguishers, automatic sprinkler equipments and fire protection appliances of all kinds and to carry on the business of a steamfitter.

F. R. Hart, J. A. Parker, Boston, Mass.; J. Scott, J. D. Wood, R. D. McGibbon, Q.C., Montreal, Que., have applied for incorporation as the Canadian Baling Co., Ltd., to manufacture baling machinery chiefly under the Lowry patents; capital stock, $1,000,000; chief place of business, Montreal.

The Cyclone Grate Bar Co., 10 King st. west, Toronto, has placed its grate bars in the following firms' plants: The Bronson Co., Ottawa; Schaeffer, Killer & Co., Waterloo, Ont.; A. Bauer & Co., Waterloo, Ont.; Hamilton waterworks, Hamilton, Ont.; Osgoode Hall, Allen Mnfg. Co., D. Gunn, Bros. & Co.

W. Thoburn and J. W. Wylie, Almonte, Ont.; E. W. B. Snider, of Saint Jacobs, Ont.; D. B. Detweiler, J. Bingeman, Berlin, Ont., and G. F. Francis, Pakenham, Ont., have been incorporated as the Michipicoten Falls Power Co., Ltd.; share capital, $40,000; chief place of business, Toronto; to develop electric power, build a pulp mill and reduce minerals.

Fred. R. Lannigan, W. H. Butters, J. H. Hough, Montreal; H. Hughes, Toronto, and Ada C. Adams, Cardinal, Ont., have applied for incorporation as the Hughes-Owens Co., Ltd.; to carry on the business of Hughes, Owens & Co. in making heliographic and lithographic papers and prepared cloths; chief place of business, Montreal; capital stock, $35,000.

The Belgo-Canadian Pulp and Paper Corporation, represented by Edmond de Vialder and Herman Cortnet, of Brussels, have contracted with the Shawinigan Water and Power Co., for 15,000 h.p., and will erect at Shawinigan Falls a 100-ton per day ground-wood pulp mill, a 75-ton sulphite pulp mill and a 100-ton paper mill. A. C. Rice, of Worcester, Mass., is engineer for the new work.

The Dominion Iron & Steel Co., Sydney, C.B., has placed an order with a Canadian firm for some castings larger than any before made in Canada. They are a couple of cylinders weighing thirty tons each, four castings of twenty tons each, and several smaller pieces of twelve tons each. These are being made at the foundries of the Laurie Engine Co., Montreal. It is gratifying to find that a Canadian firm has the facilities and the enterprise to undertake work of such a character.

The Biological Department of Toronto University has placed a large order for a number of fine instruments of precision used for special scientific purposes with the Ballard Electric and Machine Co., Ltd., of Toronto. Sometime ago the department made enquiries as to where such fine apparatus could be procured, but none of the firms approached in Canada were equipped with the necessary machines needed for such work, and had almost decided to send the order to Great Britain, France or Germany, when the above mentioned concern offered to make a trial set, which gave perfect satisfaction to the users, both in accuracy and workmanship. The placing of the order for the outfit resulted. This Canadian concern is to be congratulated for its enterprise, and since it came to the fore as a manufacturer of fine instruments it has successfully supplied many instruments which heretofore the user had to depend for his supply from foreign makers.

The McLachlan Electric and Gasoline Motor Co., Toronto, have moved from Adelaide street into a larger factory at 115 Bay street, the change being necessitated by the increase in the company's business.

Since adding mathematical instruments to its stock of artists' materials the Art Metropole, 131 Yonge street, Toronto, has had a remarkable increase in its trade, due to its connection with the best manufacturers in the world, as well as to the intelligence it has thrown into the work. They can now supply anything required by draughtsmen, surveyors and engineers at far lower prices and obtaining quicker delivery, than can be got by correspondence with foreign houses. Those ordering by mail can depend upon courtesy and promptness from this house. It is very gratifying that a Canadian house has been able to achieve the success gained by the Art Metropole in this line.

Electric Flashes.

East Toronto, Ont., will shortly call for tenders for a lighting plant.

W. E. Massey has ordered a 25-h.p. motor from the Jones & Moore Electric Co. for his farm at Little York, Ont.

The Paris, Ont., electric plant was destroyed in the fire which devastated that town on the 12th inst.

Challenor & Mitchell of Victoria, B.C., have ordered an electric plating outfit from the Jones & Moore Electric Co.

The Sarnia street railway company is asking permission of the town to convert its system from horse cars to electricity.

The Jones & Moore Electric Co. is installing a new lighting dynamo for H. J. Bird & Co., woolen manufacturers, Bracebridge, Ont.

Bracebridge will extend its lighting and power plant. C. H. Mitchell, C.E., of Niagara Falls, has been engaged to carry out the work.

P. P. Salter, of Carleton Place, is promoting an electric line to connect the C.P.R. station there with Lake Park, a suburban summer resort.

Albert College, Belleville, is now being lighted electrically, the writing being done by I. H. Breck, of Kingston. The college will have 200 lights.

At a meeting of the St. Thomas Street Railway Company on the 6th inst., it was decided to go on with the scheme to extend the electric line to Port Stanley, under the name of the Radial Ry. Co. The line is to be in operation by July 1, 1901.

The Benjamin Mnfg. Co., of Yarker, Ont., has placed an order with the Jones & Moore Electric Co. for one of their new type 225 light incandescent dynamos with all attachments, and 150 lights, wired complete in their premises.

St. Catharines, Ont., is applying to the Department of Railways and Canals for 6,000 cubic feet of water per minute from the old Welland Canal, to be used in developing power at DeCew Falls, where the plant of the Cataract Power Co. is located.

The Cape Breton Tramway and Electric Co., with a capital of $500,000, has decided to build an electric railway in Sydney, C.B., and suburbs. Glace Bay will likely be connected with the system. A line at Sydney Mines and North Sydney is also being considered.

There is a rumor that the Canadian Electric Light Co., Levis, is making arrangements to supply power to a large pulp mill which will be erected on the Chaudiere river, the stock to be offered pro rata to the shareholders in the electric company. The available supply of spruce is said to be enormous.

The development of power on the Assiniboine river in Winnipeg is again proposed. Some years ago H. N. Ruttan, C.E., Winnipeg, and J. T. Fanning, C.E., Minneapolis, made reports of this project which established its feasibility. Power is estimated to cost large users $90 per h.p. at present prices of fuel in Winnipeg, so that a great saving may be effected by introducing electric power.

Munderloh & Co., manufacturers of electrical supplies, Montreal, are sending out a serviceable metallic pocket matchbox. While the stock lasts they will be sent free to those interested in electrical work.

The Brantford Electric and Operating Co. are building a new power house, of brick with concrete foundations, water-power will be used, the capacity being 1,200-h.p. The Royal Electric Co. supply the electric equipment.

W. B. Davidson, manager of the Selkirk, Man., electric works, and only son of Canon Davidson, Frelighsburg, Que., was killed on the 11th inst., through taking hold of a lamp, which formed a short circuit through his body. He was a bright young man, only 23 years of age.

The Jones & Moore Electric Co. report among others the following recent motor sales: Yeates & Thomas, Guelph, Ont.; Tuerk Bros., Berlin, Ont.; W. H. Woodward, Cannington; Purdy, Mansell Co., R. Reinholt & Co., Brereton & Manning, W. Hayes, National Lithographing Co., Toronto.

The Rimouski Electric Co. (La Compagnie Electrique de Rimouski), has been formed with a capital of $100,000, at St. Germain de Rimouski, to furnish water and electric power to operate factories, etc. Thos. Lebel, of Fraserville; Joseph Norbert, of St. Germain de Rimouski; D. Caron, M.L.A., and A. C. Landry, of St. Octave de Metis, are chief promoters.

The United States Government undertook to send to the Paris Exhibition samples of the latest developments in machinery and scientific apparatus, free of charge to the makers. Among the electrical machinery thus selected for distinction was the Chapman voltage regulator, manufactured by the Belknap Motor Co., of Portland, Me. A number of these regulators are now in use in Canada.

Munderloh & Co., Canadian agents for the Siemens & Halske Electric Co., report that the sales of the new improved Duncan Integrating Watt Meter have rapidly increased during the past two months. This company recently equipped a large factory for the manufacture of electric light fixtures, which is now turning out what has long been needed in Canada—a well finished fixture of good design at a low price.

The Canadian Engineer thanks the Eugene F. Phillips Electrical Works, Ltd., of Montreal, for another invitation to the 22nd annual clam-bake at their parent factory, the American Electrical Works, at Providence, this month. It has been one of the writer's dearest ambitions for the last five years to attend one of these dinners, and nothing but the C.E.A. convention has kept him away this year. If the chance is open next year, the company will please reserve one seat, but cook for five, from this office.

The old Quebec, Montmorency and Charlevoix Ry., whose conversion into an electric road has been already mentioned, is now in successful operation. This road, which runs from Quebec to the celebrated shrine of Ste. Anne de Beaupre, 21 miles, carries a large number of pilgrims to the shrine as well as marketers to the city, and makes excellent time. The schedule time is 1 hour for the 21 miles, but cars make 18 stops and cross three trains in that distance. A straight run can be made, and has been made in 26 minutes. The trolley wire is suspended at a height of 22 feet above the rails, to allow of the old steam passenger and freight cars being used. In fact, steam trains still run on the line every day, the two services being sandwiched together. On one section of the line there are 48 trains a day. A copper cable of 300,000 c.m. area runs parallel with the trolley wire for most of its length, and is connected to the trolley every quarter of a mile. This cable is fed at a pressure of 560 volts at three points on the line, all the power being generated at Montmorency, and transmitted to the ends at high tension.

The Cape Breton Railway Extension Co., promoted by R. J. Campbell, of New York, and Edmund Guerin, advocate, of Montreal, propose to build a line from Point Tupper to Louisburg, through the coal district. The cost of the railway will be $3,000,000, and of a steel bridge across the Straits, $5,000,000. The company has obtained a free right of way and the usual subsidy of $3,200 a mile from the N.S. Government. The contract is said to have been let to the Manhattan Construction Co.

Mining Matters.

Silver is reported discovered on the farm of Jeremiah Mahoney, Renous River, N.B.

The Calabogie, Ont., Mining Co. has a contract to supply 10,000 tons of ore to the Midland Furnace Co., Midland, Ont.

Reports were brought down from the Yukon last month of the discovery of large deposits of coal on the Dalton trail, near White Horse.

The Nova Scotia Steel Co. has bonded all the dolomite areas at George's River, C.B. It will increase the number of coke ovens now under construction to 32.

The Standard Pyritic Smelting Co., Ltd., is to build a smelter in Greenwood, B.C. It is stated the plant for the smelter is now being built by the Denver Engineering Works Co., Denver, Col. It will have a capacity of 200 tons daily.

At River Denys, Inverness county, C.B., a deposit of silica has been reported. The deposit is in clay, sand and silica rock, and is of unlimited quantity. It is pure white, 30 feet thick and runs across the mountain, showing on the other side. It is six miles from the C. B. & O. Ry.

It is reported that the British Columbia Gold Mines, Summit Camp, has bought the water power at Cascade, B.C., which is being developed by the Cascade Water and Light Co. The falls are capable of developing 2,000-h.p. The principal owners of the B. C. mine are J. Ross and C. J. McCuaig, Montreal.

The Colonial Copper Co. is being organized in Nova Scotia to develop the copper at Cape D'Or on the shore of Minas Basin, N.S. These deposits have been known since 1604, when De Monts explored Minas Basin. Pieces of pure copper are washed out of the cliffs from time to time by the action of the waves.

The Nova Scotia Government has ordered two drills of an improved pattern to be used in the prospecting and exploration of mineral lands throughout the province. The new drills are not diamond drills, as this form of drill is thought to be not so well suited to the country rock or as economical as the drill which, instead of having diamonds in its cutting face, uses chilled steel balls.

The Granby smelter, Grand Forks, B.C., was blown in August 21st. The ores now being treated are those of the Knob Hill, Old Ironsides and City of Paris mines. Among those present at the smelter were S. H. C. Miner, president of the companies in the Miner-Graves syndicate; J. P. Graves, general manager; W. A. C. Flummerfelt, asst. gen. man.; W. G. Wooster, sec. of the smelter; H. N. Galer, asst. treas.; A. B. Rodges, supt. The power to operate the plant was got by building a dam across the north fork of Kettle River. A flume one mile long carries the water to the power house, where 1,200-h.p. is developed. A portion of this power will ultimately be transmitted to the various mines of the Miner-Graves syndicate.

Marine News.

The Rideau Lakes Navigation Co. is about to build, it is said, a new steamer, 110 feet long by 22 feet beam.

The steamer "Ottawa," built by the Bertram Engine Works Co., Ltd., Toronto, made a very successful trial trip early last month.

The Donnelly Wrecking & Salvage Co., Kingston, Ont., is raising the steamer "Oconto," sunk ten years ago, opposite Thousand Island Park.

The Jones & Moore Electric Co. has sold a 10-k.w. lighting dynamo to M. Kirkwood, Owen Sound, Ont., for his new passenger steamer now under construction at that port.

The Standard Oil tank barge No. 52 brought 204,656 gallons of oil from Sarnia, Ont., to Toronto for the Queen City Oil Co., recently, and has now been put on the Toronto-Sarnia route to make regular trips. She formerly ran to Montreal.

The R. & O. Co. is likely to build two new steamers to provide for the increased traffic between Montreal and Quebec.

The Yarmouth Times is informed that the Dominion Atlantic Ry. will have two more steamers built for the Halifax-Yarmouth and the coast routes. One will be a boat of about 320 feet, the other smaller.

The Yarmouth, N.S., Steamship Co. proposes building a new steamer at the Cramp's yards, Philadelphia. The vessel will be twin screw type, and cost about $400,000, by which amount the capital of the company will, it is said, be increased.

The Carnegie Steel Co. a short time ago wrote to Capt. Donnelly, Kingston, making enquiries as to the success of deep-laden vessels passing through the new 14-ft. canals in the St. Lawrence. The company intends using the canals more should it be found that heavily-laden vessels can travel through them in safety.

Z. Malhoit, C.E., of the Dominion Government engineering staff, is making a resurvey of the Red River from Emerson north to estimate the cost of making the river navigable. The work so far has been completed from Winnipeg north to the mouth. He will, if possible, locate a straight permanent channel at the mouth of the river, and will devise some means of keeping the channel free from deposits of sand and sediment.

Railway Matters.

The new Midland Ry., of N.S., between Windsor and Truro is to be in operation about November.

The double tracking of the G.T.R. from Hamilton to Niagara Falls, Ont., 44 miles, is to cost $500,000. Rogers and Taylor, Montreal, have the contract.

The Lake St. John Ry. has been seized by the bondholders, who have agreed to advance $170,000 to improve the rolling stock, terminal facilities upon the surrender of 51 per cent. of the capital stock of the company.

Foley Bros. & Co., St. Paul, Minn., have the contract for 100 miles of the Algoma Central Ry. from Sault Ste. Marie to the C.P.R. The contract includes the erection of a large dock at Sault Ste. Marie, and two bridges.

The extension of the Pontiac Pacific Junction Ry. from Aylmer to Hull, Que., is expected to be finished this fall. The P.P.J. Ry. and the Ottawa & Gatineau Valley Ry. will have a union station in Hull. The P.P.J. line is to be carried under the C.P.R. in a tunnel.

On the Rainy River Ry. 60 miles have been laid to the west and 120 miles graded. About 2,000 men are employed, and this will be increased to 3,000 during the winter. Wm. Mackenzie said recently that the road would be completed to the south-eastern terminus in the fall of 1901.

The Canadian Northern Ry. in offering $5,000,000 worth of its bonds stated the advantages of the road as including cash and land guarantees granted by the Dominion and Provincial Governments, local traffic assured by the territory which the line will traverse between Lake Superior and Manitoba, embracing the Rainy Lake and Rainy River districts, rich in minerals, timber and agricultural lands, and it also taps the rich Saskatchewan valley with farming lands and coal areas.

A movement is on foot in Victoria and Inverness counties, C.B., urging Mackenzie & Mann, owners of the Inverness Ry., to build a line from the Inverness Ry. and carry it through Northeast Margaree, Middle River, to Baddeck, thence via Big Harbor and down the northern shore of the Big Bras d'Or Lake to the Islands, thence crossing the Big Bras d'Or and running down Boularderie to Point Aconi, thence to Sydney Mines and North Sydney.

The Clergue syndicate has bought the charter of the Ontario, Hudson Bay and Western Ry. for about $100,000, and will continue the Algoma Central Ry. up to the James Bay. The O., H. B., and W. Ry. in 1899 got a bonus for the road between Missanabie Station, on the C.P.R., and tidewater at the mouth of Moose River on James Bay, of $2,000 a mile, in all $480,000. It was also given a land grant of 5,000 acres per mile.

The Inverness and Richmond Railway Company, controlled by Mackenzie and Mann, of Toronto, and the Broad Cove Coal Company have amalgamated, under the name of the Inverness Richmond Railway and Colliery Co.

What is stated by an exchange to be a record for track relaying was accomplished on August 12 on the Grand Trunk Ry. between Dorval and Ste. Anne de Bellevue, when 120 men under General Roadmaster McCooe, assisted by Roadmasters Nolan, Galvin and Henderson, put down eight miles of rails without the least interruption to traffic. The best previous mark was made several years ago, on the southern division, where 108 men relaid a few yards over six miles of rails. The first spike was drawn at 7 o'clock and the entire distance, a couple of hundred yards less than eight miles, was completed before 6 o'clock.

Personal.

W. G. Webber, late of Rice Lewis & Son, Toronto, has taken a position with the Sault Ste. Marie, Ont., Pulp Co.

W. E. Gower, C.E., Montreal, is going to England to reside as representative in Great Britain of the American Stoker Co.

M. Stanley, formerly of Perth, Ont., manager of the car shops of the Birmingham, Eng., tramways, moved his family over to England from Perth last month.

Alex. Horn, Dominion Inspector of Hulls, died recently at his home in Kingston, after a brief illness. Deceased was appointed to the position of inspector last spring on the retirement of Capt. Donnelly.

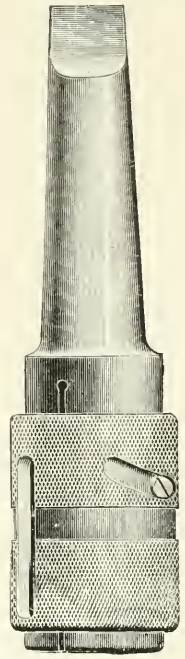
James Bow, of Rat Portage, inspector of mines under the Ontario Government, has resigned, to take a position with the Anglo-Canadian Gold Estates. He will have charge of their prospecting work in the Seine River district.

Capt. P. J. Larkin, of the contracting firm of Larkin, Connolly & Connolly, and formerly one of the best known lake captains, died at his home in St. Catharines on the 31st August, aged 71 years. He carried out many large public works, the last being the enlargement of the Iroquois section of the St. Lawrence canals.

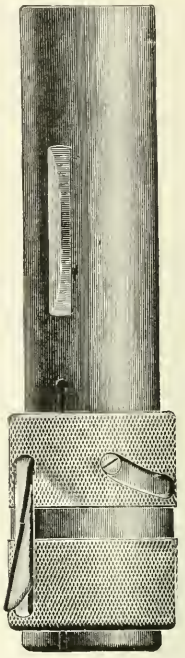
H. Tandy, superintendent of the Kingston locomotive works, says he will remove next month to the States, as he sees no hope of the works being carried on, after the failure of the recent sale. There was much disappointment that the Dominion Government did not give the company a chance to tender on the locomotives that were recently ordered in the United States.

THE SIMPLEX DRILL HOLDERS.

With reference to these sockets or drill holders, illustrated above, the makers claim that they have many advantages over any other ever offered on the market, of which the following is an extract: 1st. You require no wrench, key, drift or hammer to remove drills. 2nd. The great number of drills each holder will accommodate. 3rd. The small diameter of these holders enable the operator to get close to the work required to be done, in the case of drilling close to angles or anything of that description. 4th. In point of convenience and quickness it has no equal, as the drills can be put in and taken out while the machine is in motion, rotating at a speed anywhere from 100 to 500 revolutions per minute, and by so doing increases the output of the machine 25 per cent. 5th. The locking and driving device is absolutely positive, there being no way in which the drills can slip or move from position. The Simplex drill holder is put on the market by the manufacturers, Messrs. J. Lumsden

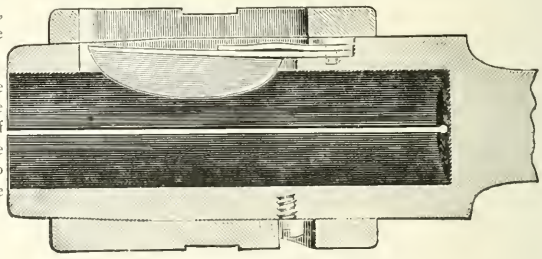


SIMPLEX TAPER SHANK HOLDER MORSE STANDARD TAPER



STRAIGHT SHANK SIMPLEX HOLDER.

& Co., 375 St. James street, Montreal, and since their introduction they have equipped many of the leading railroad shops and iron working plants in Canada, and inasmuch as the members of the firm are well-known and well posted men in the supply trade, their business in general supplies is increasing in a very gratifying manner.



SECTIONAL CUT OF SIMPLEX DRILL HOLDER CHUCK, SHOWING METHOD OF LOCKING AND UNLOCKING.

LATHE HAND. A lathe hand wants employment. Address W. N. G., care Canadian Engineer. 5-1

To Machinery Merchants! BRITANNIA CO., COLCHESTER, ENGLAND, makers of nearly 300 varieties of Lathes, Planers, Shapers and other Engineers' Tools, are open to appoint a sole agent in Canada. They are also open to act as English agents for a first-class Canadian firm, and they have unusual facilities for introducing any engineering specialties. 6-3

NOTICE

The proprietor of a Foundry, Boiler and Machine Shop in a manufacturing centre near Montreal, on account of ill-health and advised by his doctor, will sell on very good conditions and with long terms of payments, his business, plant and property. This factory is the only one of its kind in the locality and is in a flourishing state. A splendid opening for engineer or machinist that could dispose of a small capital.

Address "BUSINESS CHANCE," Care of The Canadian Engineer, MONTREAL.

9-1

SCIENTIFIC TEMPERING.

Important to Machinists and Manufacturers. The method of hardening employed by The Dominion Button Works, Montreal, has proved remarkably superior to every other system. A department for outside work was opened last spring. Already some of the most important manufacturers in the city get their hardening done by the new process. Milling Cutters, Reamers, Dies and Punches, Taps, Jewellers' Tools, Case Hardening, **and anything that needs temper,** 100 per cent more wear guaranteed. Every piece warranted. Correspondence solicited. References given. Agent will call if required.

DOMINION BUTTON WORKS, 498 Visitation St., MONTREAL.

The Canadian Engineer

VOL. VIII.—No. 6. TORONTO AND MONTREAL, OCTOBER, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE		PAGE
Abbott-Mitchell Iron & Steel Co.	118	Lead and Zinc of Missouri	117
Accidents	132	Literary Notes	124
Advertising Agencies	114	Marine News	130
Brown & Sharpe	120	Mining Matters	129
Can. Society of Civil Engineers	117	Mining, Kingston School of	131
Catalogues	124	Nickel Extraction, the Frasch Process of	114
Chemical Exhibition, German	115	Peat Fuel Manufacture	115
Chimney Construction	113	Personal	130
Cobra, Speed of	120	Pig Iron Production of Canada	116
Converters, Rotary	111	Railway Matters	127
Dynamo in Telegraph Offices	132	Rotary Converters	111
Electric Flashes	128	Storage Battery in Telegraph Offices	132
Engineer, Master Spirit of Age	133	Turbines, Steam, Speed of	120
Fires of Month	132	Ventilation and Heating	121
Frasch Process of Nickel Extraction	114	Viper, Speed of	120
Imperial Trade Notes	123	White Metal	120
Industrial Notes	125	Zinc Industry of Missouri	117
Iron Production of Canada	116		
Kingston School of Mining	131		

CHIMNEY CONSTRUCTION. *

BY E. J. PHILIP.

The construction of chimneys does not give us much thought, like many other things we have to deal with, until we have to construct one; and when you begin to look up facts, it will surprise you how little real information there is to be had on the subject. In the Old Country, where there are many large chimneys, used for all purposes, there is on record much information both in reference to building, strengthening and taking down. Most of the very high chimneys are used for other purposes than producing draught to burn coal; such as carrying off the poisonous gases from chemical works, etc. There is a book published called, "Tall Chimney Construction," which gives the general details of many stacks built in the Old Country, and from these records you can make formulae to guide you in designing a new stack. Let us consider what is the proper method of designing a chimney for any given purpose. The first question is: "What is the chimney for, or what is it to do?" for this will govern some details of the shell. For instance, if it is to produce draught for ventilation, it will not require to be lined with fire brick, nor will there be any benefit in putting in a loose lining. We will suppose the chimney, under our consideration, is to induce draught to burn coal; as that is the most likely duty of any chimney that we will be connected with. The size of the flue is the first dimension you will require, and it will depend on the quantity of coal to be burned, and the velocity of the gases up the shaft; it is easily understood that as chimney powers increase, the dimensions do not increase proportionately. To illustrate this, I will take some figures from a table in a reliable work: A chimney 70 feet high, 30 inches diameter, = 100 h.p.; a chimney 200 feet high, 66 inches in diameter, = 1,000 h.p.; that is, the high chimney with five times the area equals ten times the power; and, while I am not sure that this proportion is right, it seems to illustrate the way the formulae work, the only correct way is to calculate the number of cubic feet of gas going up the chimney at the average velocity and the area of this column is the area of the chimney; the rate of combustion depends on the draught, and the draught depends on the height of the chimney and the temperature of the gases. The height of the stack is nearly always determined by the surroundings, as the stack must of necessity be above any buildings or hills, and I might say that the average stack is higher than is necessary. However, when there are no buildings or hills, the following formula will establish the height.

This is known as Gale's formula: $H = \frac{120}{T}\left(\frac{F}{G}\right)^2$

After getting the height, the area may be obtained by Kent's formula, which is: $A = \frac{.06\ F}{\sqrt{H}}$. In this rule the effective area is obtained, and is two inches less all around than the actual area. This two inches is to make up for friction of shaft. We now have area of chimney and height of it. I might say that experience has shown that to burn hard screenings requires 175 ft. stack; for buckwheat, 150 ft., and for soft coal, 80 to 100 ft. This is a pretty fair basis to start from. We will suppose our chimney is, say, 100 ft. high and 40 sq. ft. area. It looks a simple matter to construct a stack, having this information, and so it is, only you must go about it in the right way. To continue your calculations; after getting the size, you start at top and work down. Authorities say that a chimney having a flue over five feet in diameter shall be 1½ bricks thick at the top, and from three to five feet in diameter, one brick; and under three feet, one-half brick; a chimney five feet or over would have this size for the first 25 feet down, and would increase one-half brick for each 25 feet. This, according to calculations, is almost too much. It can run 30 to 40 feet each stage, but will depend on the kind of material; that is, whether hard or soft brick, and whether built in cement or lime; 30 to 40 feet will work with good material and workmanship. Having laid out the different thicknesses of wall and knowing the batter, which varies with different builders and conditions, from 1-16 to ⅜ of 1 inch; hav-

*A paper read before the Canadian Association of Stationary Engineers.

ing this you can get the weight of shaft or chimney proper. In large chimneys it is usually specified what they shall weigh per cubic foot. After getting weight you can decide how much bearing surface you will require for the kind of soil you have at the foundation. Various bearing powers of soils are given, as follows: Hard rock, native bed, 100 tons, sq. ft.; clay, dry, 4 to 6 sq. ft.; moderate dry, 2 to 4 sq. ft.; soft, 1 to 2 sq. ft.; gravel and coarse sand, 8 to 10 sq. ft.; sand, compact and well cemented, 4 to 6 sq. ft.; clean, dry sand, 2 to 4 sq. ft.; quicksand and alluvial soils, ½ to 1 sq. ft. When the ground is soft, you would require piling or timbering, and to spread it out over a considerable surface. The weight in tons, divided by bearing power of soil gives surface required. Wind pressure is also an important factor in getting the area of the base. I will not go into the rules considering wind pressure, but experience has shown that at the base of shaft proper its diameter shall be 1-10 of height for square chimney; 1-11 for octagon, and 1-12 for round. In considering wind pressure, it is usually figured at from 25 to 56 lbs. by different authorities. This must be resisted by foundation, as you can see, if the chimney rocks over with wind, it will throw its entire weight on one side of foundation. In considering wind pressure, it is necessary to take into account whether the chimney is protected by buildings or standing in an open field. If the chimney is built into a building, windage may be almost disregarded, except for a piece above the roof.

As to the merits of the different shaped flues, experience and tests have shown that a parallel flue is the best, or as good as any shape. The arguments for taper flues are something like this; that the gases slow down, due to cooling, as they go up, and consequently they require more loam, and the flue should get larger; others say that the gases, cooling down, contract in volume, and therefore the flue should get smaller so as to take the same shape as the column of gas; experience has shown that both are correct, the gases contract and get smaller, and consequently need less room; but they also slow down in velocity, due to their greater weight, and therefore need more room; in this way they just balance up, and require a parallel flue. Authorities say a round parallel flue is the best for all purposes, and the nearest approach to this is next best. The chimney should be finished with a cap of some material that will stand the weather; I like cast-iron best, but a cap can be moulded of Portland cement, and, if the stack is for smelting works, of fire clay. These materials stand well, and if there is a ladder on the chimney, they can be kept in repair; a ladder should always be built on the shaft, as it makes a means of examining it at any time, and if repairs are needed they can be done easily. Lightning conductors are also approved and disapproved, but if a chimney is the highest object in its vicinity, it is likely to take the discharge from a storm over it, and a properly erected conductor will carry it off.

THE ADVERTISING AGENT.

After giving the matter some study and ascertaining the practice of our most reputable contemporaries, we have decided to cease paying commissions to advertising agencies. We have come to the conclusion that the advertising agency is in the impossible position of the man who tries to serve two masters. Having his own interests to serve and living on commissions, he cannot faithfully represent the advertiser and do justice to the paper that may or may not allow him 25 per cent. of the contract. If the paper declines to allow him any commission—and the best trade papers now do refuse to pay this tribute—is he likely to commend such a paper, since he would be working for it for nothing? This question has only to be thought out in all its bearings to enable the discerning advertiser to come to his own conclusions. These remarks have no reference to the man who is paid specifically by the advertiser to look after his own advertising. Within the past month we have had several letters from New York advertising agencies, stating that they had been authorized by clients to place contracts with a good Canadian trade paper, and that the business might be put in the Canadian Engineer, if our "prices are right." Now, we may say that our prices are very right. We have uniform rates for all business announcements, and from these rates there is no discount, except that of five per cent., where an advertiser pays for the year in advance; and no commission is now allowed to advertising agencies. We shall be pleased to do business with any reputable firm, except patent medicine people and firms that have no connection with the engineering trades—such advertisers we do not want at any price —but the business must be done direct with the Canadian Engineer, or its own traveling representative.

THE FRASCH PROCESS OF NICKEL EXTRACTION.

The Nickel-Copper Co., of Ontario, Limited, has been experimenting recently with a new process of nickel and copper extraction, which is the invention of H. A. Frasch. The representative of the Engineering and Mining Journal, of New York, was present at one of these experiments, made at the company's works at Hamilton, and we have extracted the following from among the observations which he reported:

The Nickel-Copper Co., of Ontario, Limited, under whose auspices the process was shown, is controlled by the following officers: A. T. Wood, president; John Moodie, treasurer; John Patterson, secretary. The company was organized to mine and smelt the nickel-copper ores of Sudbury, bringing them to the condition of nickel-copper matte, and it held a contract with the Hoepfner Refining Co., Limited, for the treatment of this matte to produce the copper and nickel contents in a metallic state. The Hoepfner Refining Company was unable to develop its process of refining economically, and the Nickel-Copper Co. secured the services of H. A. Frasch for the development of a satisfactory refining process.

The process, as applied to the Sudbury copper-nickel matte, consists in the electrolysis of a brine solution in such a manner that while the sodium ions are set free at the cathodes with the formation there of caustic soda, the chlorine ions are liberated in the anode section containing the matte and immediately form a chloride solution of the metals present. In this way brine is electrolyzed to form caustic soda, at less expense, it is claimed, than with the insoluble anodes in the Catsner-Kellner or Rhodin processes, and

at the same time the chlorine instead of being made into bleach is utilized for the formation of the chlorides of copper, nickel, and iron and other metals that are in combination in the matte at the anode poles. The metallic chlorides can be directly treated for the contained metals by electrolysis or chemical methods, or after being electrolyzed of half the content of copper (corresponding to the conversion of the cuprous salt to the cupric salt), they may be used for lixiviating the metals in the raw matte, the copper chloride solution being in the cupric condition acts chemically as a solvent for the metals in the matte and reforms the electrolyte solution suitable for further electrolysis. Eventually the metals in the solution are recovered by electrolytic deposition, or, in the case of nickel and cobalt, the nickel is separated from the cobalt as a chemical salt by a method which Mr. Frasch declines as yet to make public.

The matte is crushed and is then conveyed to the vats, where it is charged directly on a layer of carbonaceous material, that forms the anode section at the bottom. On this layer of matte is placed a thin layer of sand, which gives a very satisfactory diaphragm for the separation of the resultant solutions of caustic soda and the chlorides of the metals. The anode section of the vat is then filled to the sand layer with a saline or a weak chloride solution from a previous operation, and the balance of the vat is filled with water or with a weak caustic solution. The passing of the two solutions from the reservoirs to and through their respective anode and cathode sections of the vats and thence to receiving tanks is accomplished mainly by gravity. The subsequent handling of the solid material, which remains in the anode section after treatment, consists of the removal of the upper layer of sand, which can be washed and used again, followed by the removal of the leached material, from which perhaps it might prove economical to extract the sulphur.

The matte under treatment was of the composition: Copper, 31.8 per cent.; nickel, 14.8 per cent.; iron, 25 per cent.; sulphur, 24 per cent. The first solution from the anode section contained, in grains per liter, copper, 50; nickel, 43, and iron, 26.6, and after the removal from this solution by direct electrolytic deposition of one-half the copper content, a second percolation through the anode section gave a solution that contained, in grains per liter, copper, 50; nickel, 60, and iron, 35. By a further intermediate removal of the copper from the chloride solution with intermediate percolation through the anode section or sections, the percentage of nickel can be raised to any desired degree. In the tests that were carried out at the works of the Nickel-Copper Company the results obtained fully reached the theoretical quantities, it is stated. It is claimed that the entire cost of the process will be fully met by the value of the caustic soda and other by-products.

PEAT FUEL MANUFACTURE.

In the March issue of the Canadian Engineer we published an article by A. G. Ardagh, proprietor of the peat fuel plant at Brenner, Ont., on the process of manufacturing peat. The process seemed to promise great developments, but so far we are unable to discover that these developments have taken place. In May last, we wrote all the companies owning plants, and in none of the replies was it stated that peat was being produced on what would be considered a commercial scale. We are told that the parent companies and the various subsidiary companies are "on the point of overcoming serious obstacles." We heard this also when we first heard of the process. Unfortunately, two of the larger plants were destroyed by fire recently, and so our data is more meagre than otherwise would have been the case. We are given to understand that the heating of the compression cylinder, which at first caused considerable difficulty in operating the machine continuously, has been overcome by an improvement in the water jacket. There are, as yet, none of these cylinders which have been in continuous use long enough to demonstrate their probable life. The pressure to which they are subjected is of the nature of a series of violent blows, and it is possible that the life of the cylinder may be shorter than has been supposed owing to molecular charges consequent upon this repeated pressure. The life of the whole machine also has to be demonstrated. A good deal of difficulty has attended the drying of the crude peat, which is the first step in the process. Natural drying takes a great deal of time and an enormous amount of manual labor, and artificial requires fuel and a plant more or less expensive. These items are, of course, merely relative; but a product that is to be put on the market at a low price per ton must be cheaply dried, especially when the amount of moisture to be extracted is considered. In many cases the moisture equals 90 per cent. of the total weight. To get one ton of peat fuel ten tons of crude peat must be turned over for the first drying and the mass is in some cases turned over three times before being fed into the machines.

THE GERMAN CHEMICAL EXHIBITION.*

It is not a recent thing for those who can see a little farther than the end of their noses to vie with each other in repeating that the exposition of 1900 would be the apotheosis of German industry. They were not heeded. They were even looked at a little askance; for in certain circles where the ostrich is imitated, the rule is, that the superiority of others cannot be announced without committing a sacrilege.

A few visits to the Champ de Mars are sufficient, alas, to convince oneself that these pessimists were not altogether wrong, and that the German industrial exhibition is something marvelous, extraordinary, "kolossal," as they would say on the other side of the Rhine.

The exhibit is organized by a central committee composed of Dr. Holtz, president; Dr. Martius, vice-president, and Messrs. Boettinger, Kroemer and Haueisen, and is divided into eight groups.

Group 1 is devoted to greater chemical industry in general (President Dr. J. Stroof). Here the potash salts industry, of Stassfurt, of which Germany exports nearly twenty millions worth a year, has, so to speak, a monopoly.

Here also is that yellow liquid in which all metals except iron would dissolve like sugar in water—liquid chlorine obtained by electrolysis. Common salt, chloride of sodium, has been decomposed by electricity. The

*Translated from Le Figaro, June 12, 1900, by Prof. Chas. F. Kroh, Stevens Institute of Technology, Hoboken, N. J.

sodium passed over to one pole, while gaseous chlorine was collected at the other and had only to be liquefied afterwards by well known means.

Here are shown samples of chromium, manganese, titanium, etc., all pure metals, absolutely free from carbon. They bear witness to the excellence of the new method invented by Hans Goldschmidt and known as aluminothermy, which utilizes the formidable temperature of the combustion of aluminium. When metallic oxides are heated in the presence of aluminium, such a heat is developed in the crucibles that nothing can resist it, and the most refractory metals can be welded together.

Alumina itself is melted, and on cooling, is transformed into corundum studded with little artificial rubies. To start the reaction, only a jet of flame or even a single match is required; the affinity of the aluminium for oxygen does the rest.

Synthetic sulphuric acid is also found in the same group. No more clumsy and expensive leaden chambers in which dilute sulphuric acid was formerly manufactured, which had then to be concentrated in platinum apparatus as costly as the jewelry of a great coquette. At the present day, anhydrous sulphuric acid is prepared cheaper and with the greatest ease by combining directly the oxygen of the air with the sulphurous acid coming from the roasting of pyrites in the presence of platinized asbestos, and then it needs only to be diluted for commercial purposes. But if it is true that the state of advancement of a civilization should be gauged by the amount of sulphuric acid it produces, what must we say of a country which has carried this paramount industry to such perfection?

Group 2 (President Dr. A. Merck), contains the pharmaceutical products for which Germany indisputably holds the record, from the alkaloids, antipyrine and saccharine to the serums of Behring and Koch, and those magnificent substances called "radio-actives" on which the radiography of to-morrow will operate.

Group 3 (President Mr. Voigt), is that of smaller chemical industry with rare earths, the generators of incandescence, photographic products beginning with eikonogen, orthochromatic plates, etc., while group 4 (President Mr. Stueckelen), is reserved for mineral colors, lacquers, varnishes, and products extracted from bone, such as gelatine and glue.

The artificial perfumes, which are little by little crowding out the natural perfumes, form group 7 (President, Dr. A. Steche). This is another specialty in which Germany is almost without a rival, thanks to the regretted Tiemann, who discovered vanillino, heliotropine and artificial violets.

Group 8 (President, Dr. Heraeus), is devoted to utensils of all kinds that are employed in chemistry from the microscopic retorts used in the laboratories to the gigantic apparatus of great manufactories. Here Dr. Linde exhibits his ingenious machine for manufacturing liquid air.

But the acme and culmination of the exhibit is to be found in groups 5 and 6, presided over by Dr. Druneck, director of the Badische Anilin & Soda Fabrik and a member of the jury. Here, in a logical and suggestive order, are arranged the derivatives of coal tar benzine, from which the aniline dies are obtained, naphthaline, which is used to manufacture artificial indigo and azo-coloring matters, and finally anthracene, the source of artificial madder. All this is surmounted by a pile of coal representing exactly the quantity of raw material from which the collection was produced.

Nevertheless, the industry of coal tar coloring matters did not originate in Germany. It is of French and English origin. But that does not prevent it from vegetating to-day in England as well as in France, while in Germany it reigns supreme in numerous works, a single one of which employs no less than 6,500 workmen and 150 chemists, doctors of science.

The appearance of large quantities of the Badische Anilin & Soda Fabrik's artificial indigo in the market in 1897, for example, dealt such a blow to the indigo plantations of India, that they were seriously endangered. In two years, the area of the indigo fields of north-western Hindoostan decreased from 1,876, to 953 square kilometers. In the same way the discovery (also German) of chemical madder formerly compassed the complete ruin of the Provencal cultivation of madder.

To be sure the process for the synthesis of indigo employed by the Badische Anilin & Soda Fabrik is not the only one there is. Others are known, one of them starting with Toluene. But all the factories in the world would be insufficient to produce Toluene enough to supply the demand. The process of the Badische Anilin & Soda Fabrik, moreover, has the merit of getting indigo, which is very valuable, from naphthalene, which costs almost nothing.

I will stop here, having said enough apparently to give a summary idea of the prodigious development of that German industry, whose crushing shadow falls upon us, but which has, nevertheless, worked gloriously—why not recognize it?—for the fortune, the power and the comfort of the human race?

We may deplore the fact that on this account we do not occupy any longer so great a place in the domain which was formerly ours, but it is not sinning against patriotism—on the contrary—to salute the work accomplished by others with admiration, respect and even gratitude.

EMILE GAUTIER.

PIG IRON PRODUCTION OF CANADA.

The production of pig iron in the Dominion of Canada in the first half of 1900 is estimated by the American Iron and Steel Association, which claims to have received returns from every manufacturer of pig iron in the Dominion, to be 45,234 gross tons. The total production in the whole of 1899 amounted to 94,077 tons, against 68,755 tons in the whole of 1898. Of the production in the first half of 1900 about one-sixth was made with charcoal as fuel, the remainder being produced with coke alone. In the first half of 1900, Canada produced both Bessemer and basic pig iron, two companies manufacturing Bessemer pig iron and one company manufacturing basic pig iron. The production of Bessemer pig iron was about one third of the production of basic pig iron. Neither spiegeleisen nor ferromanganese was produced in Canada during the first half of 1900, the Mineral Products Co., of Hillsboro, New Brunswick, having given up its lease of the Bridgeville furnace, at Bridgeville, Nova Scotia. The furnace was blown out in November, 1899. This company will confine its operations to the production of manganese ore. The furnace was idle from November, 1899, to June 30th, 1900. The unsold stocks of pig iron in Canada on June 30th, 1900, in the hands of manufacturers or their agents, none of which was intended for consumption by the manufacturers, and all of which was for sale, amounted to 13,672 gross tons, against 9,932 tons on December 31st, 1899. The number of com-

pleted blast furnaces in Canada on June 30th, 1900, was nine, of which four were in blast and five were out of blast. On December 31st, 1899, there were also four furnaces in blast and five out of blast. Of the total number of furnaces in Canada four use coke as fuel, four use charcoal and one used charcoal and coke when last running.

THE LEAD AND ZINC INDUSTRY OF SOUTH-WEST MISSOURI.*

BY F. W. DRAPER, B.SC.

(Concluded from August issue).

The jigs are generally six compartment jigs of the plain eccentric pattern and are expected to produce a marketable product. The ore crushed to ½" is fed on without any attempt at classification. As a result all particles of blende and all included grains, which are lighter than the heaviest pieces of chert, are lost. What this loss amounts to may be readily seen by an examination of the tailings dumps or by observing the yellowish scum on the water overflowing the last compartment of the jigs. The jigs make hutch on all sieves and also concentrates. If galena is present, the jig will be so regulated that the hutch and concentrates of the first sieve are pure galena, while the blende is caught on the remaining sieves. Owing to the great sp. gr. of galena, a clean product may be obtained with almost no loss of mineral. But this is far from the case with the blende. Although it is hard to obtain figures it is very doubtful if more than 75 per cent. of the Zns. is recovered. It is generally figured, however, to rejig heads to eliminate further gangue, the first jig being run so that considerable chert is found in the heads. This is undoubtedly done in the endeavor to lessen the great loss which is inevitable with the system employed. This showing on an ore which should be an easy concentrating proposition, shows the need of expert advice to the companies operating in that field.

In the winter of 1898, the writer found in operation only one mill where any attempt at graded crushing was made. This was at the Kohinoor mill, near Joplin, and I was informed that it was the only mill in the whole district where such a thing could be found. At this mill there obtained the same bad practice of passing everything, regardless of its size, through the crushers and rolls, the latter set tightly together. In this particular instance the crusher ran at 380 revolutions per minute, and seemed in imminent danger of tearing to pieces its whole foundation. But the engineer informed me that it had been going at that rate for nearly a year and had never given trouble. The sieve scale was 12½ mm., 8 mm., and 2½ mm. The material coarser than 12½ mm. was returned to the rolls; between 12½ and 8 mm. went to roughing jigs, making heads and tails. Heads are recrushed and sent to 8 mm. screen. Material between 8 and 2½ mm. was jigged on 6 sieve jigs, making hutch, discharge and tails. The discharge was crushed and passed to 2½ mm. screen, while hutch was clean. All material passing through 2½ mm. went to a pointed box with two compartments. The first spigot was sent to 4 sieve jigs making clean heads and tails. The second spigot and overflow went to revolving tables. This mill was undoubtedly a step in the right direction, although it had many defects. At the time of my visit it was running on residues from the zinc smelter and I could thus obtain no idea as to the efficiency, but it certainly should have been able to save a much greater percentage than its neighbors.

The last year has witnessed a great change in conditions in this field, the small operators being absorbed by large companies with strong financial backing, and this change will undoubtedly be followed by an entire change in the ore dressing scheme. So that in the near future we may expect to find here the same efficiency of concentration as is found in other districts on other kinds of ores.

The Smelting Industry.—The ores produced in this field have in the past been smelted mostly in three districts. 1st at La Salle and Peru in Central Illinois; 2nd, at St. Louis and neighboring towns in Illinois, and 3rd, in the ore-producing districts themselves, Joplin, Pittsburg and Kansas. In each of these three districts coal has been found in the neighborhood. The recent discovery of natural gas in south-eastern Kansas has caused the removal of most of the smelters to that portion of the State. The gas field is on the outskirts of the zinc district, and the question of transportation thus becomes of minor importance. The natural gas makes an ideal fuel for zinc production. The Belgian system is universally followed. At the present time the smelting industry intends to concentrate at Iola and Cherryvale, Kansas, where natural gas is available. The production for the last two years was as follows:

	1898.	1899.	Gain.
Illinois and Indiana	46,693	50,388	7.9%
Missouri and Kansas	59,606	76,593	28.3%

*A paper read before the Applied Science Society of McGill University, session 1899-1900.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The Canadian Society of Civil Engineers held a very successful summer meeting in Ottawa, Ont., Sept. 13th-16th. The local committee which had the arrangements in hand consisted, among others, of Messrs. G. A. Mountain, C.E., chairman; Guy Dunne, C.E.; Paul Weatherbe, C.E.; Robert Surtees, C.E.; S. R. Poulin, C.E.; N. J. Ker, C.E.; C. H. Keefer, C.E., C.M.G.; G. L. Bourchier, C.E.; Robert Bruce, C.E., and O. Hyman. These gentlemen by their untiring energy and unfailing courtesy had very much to do with the success of the meeting. A special meeting of the city council was held, and the Mayor extended a cordial welcome to the visitors. Then the visitors were taken in special cars to Britannia, where the works of the Metropolitan Electric Co. were inspected. A business meeting at the Russell was held in the evening of the 13th with a large attendance of members, President Bovey presiding. A general discussion took place on some of the routine affairs of the association, and it was urged that the individual members should prepare more papers to be read at the annual meetings for publication in the annual report. Much useful information, it was thought, could thus be interchanged and disseminated. The society adopted votes of thanks to the city and to all who took part in making their visit to Ottawa a pleasant one. Among those registered as in attendance on the first day were the following: W. T. Jennings, E. H. Keating, Toronto; R. Forsyth, Montreal; James Hutcheon, Guelph; A. Rhodes, Quebec; Rod. MacColl, Halifax; C. H. Mitchell, Niagara Falls; George A. Mountain, Guy Dunne, Paul Weatherbe, Robert Surtees, S. R. Poulin, N. J. Ker, C. H. Keefer, G. L. Bourchier, Robert Bruce and O. Hyman, Ottawa; T. C. Keefer, E. E. Perreault, C. A. Bigger, W. P. Anderson, Morley Donaldson, G. B. Perley, H. D. Bush, Paul Paradis, W. D. Harris, G. S. Maunsell, E. Lafleur, A. St. Laurent, F. Fraser, N. Valiquette, A. Campbell, F. Thompson, Joseph Roy, Ottawa; R. W. Leonard, H. T. Bovey, Gordon Pyke, W. Kennedy, F. Thompson, F. W. Lesage, H. Gauthier, T. Jermyn, C. H. McLeod, Geo. Holland, Montreal; J. H. O'Sullivan, H. O'Sullivan, Indian Lorette; E. Evans, G. S. Oliver, Quebec; F. Miller, Napanee; J. L. F. Miller, Pembroke; J. Sullivan, Valleyfield.

On the morning of the 14th the engineers visited some of the great industries which have done so much to build up Ottawa commercially. The E. B. Eddy Co.'s works are being restored on an extensive scale, and though the machinery was not in position at the time of the visit the engineers saw enough in the preparations going forward to enable them to appreciate the application of water-power to industries on this scale. Under the personal guidance of J. R. Booth, that gentleman's large saw mills at the Chaudiere were examined next. The calcium carbide works, however, were not seen by the civil engineers, as the manager was out of town, and it was said that the public were excluded from the premises. The rest of the morning was spent in viewing the Interprovincial bridge, which is being built between Ottawa and Hull by the Dominion Bridge Co., Ltd., Montreal, a sketch of which will appear in next issue.

When the examination of this interesting piece of engineering work had been completed the visitors were entertained to luncheon by the Dominion Bridge Co., at Rockcliffe, the Ottawa end of the bridge. In the afternoon the garden party given in honor of the Canadian Society of Civil Engineers by T. C. Keefer, C.E., C.M.G., at his beautiful residence and

grounds, "Rockcliffe," was one of the most delightful events of the season in Ottawa society it is said. Ideal weather favored the occasion, and enhanced its success. The guests were welcomed by Mr. Keefer, an old and honored ex-president of the Engineers' Association, and spent a few hours enjoying his hospitality. Charming music, furnished by the full band of the Governor-General's Foot Guards, enlivened the occasion, and on the lawn refreshments were served. In the evening a conversazione was held at Victoria Hotel, Aylmer. The return to town in the early hours was accomplished by the electric railway with transfers over the as yet unrestored portions lying between Hull and Ottawa.

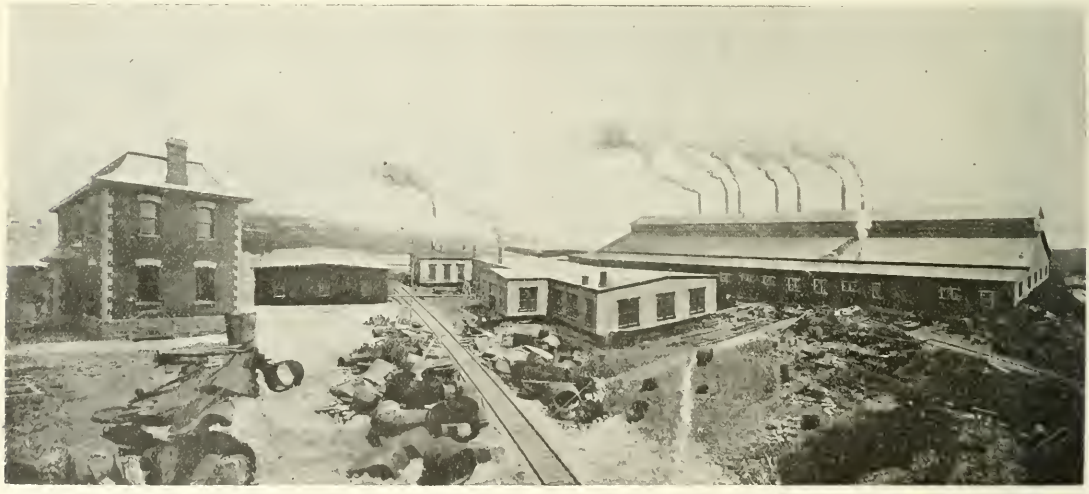
On Saturday morning by the invitation of President J. R. Booth and the directors of the Canada Atlantic Ry., the engineers to the number of about one hundred were taken by a special train of Pullman and private cars from Ottawa to Parry Sound and Depot Harbor to examine the company's line and terminal facilities. Through the kindness of G. A. Mountain, chief engineer, C. J. Smith, general traffic manager, and J. E. Walsh, assistant general passenger agent, the various objects and points of interest along the line were pointed out. President J. R. Booth, Gen. Man. Chamberlin and Gen. Supt. Donaldson were unable to accompany the party, as on the same day they were accompanying the Montreal Corn Exchange over the eastern portion of the line and down the Soulanges Canal. The journey to Parry Sound was pleasantly accomplished, and on arrival there the wharves, transfer sheds and elevators were examined A trip round Depot Harbor and Parry Sound harbor was made in a steam tug, and the afternoon of the beautiful early autumn day was fittingly closed. On the westward journey luncheon was served at Madawaska, and in the evening a dinner was given the visitors at the Rosebank Hotel, which is situated on a gentle slope facing the narrows, which separate the two harbors, and about two minutes' walk from Parry Sound. G. A. Mountain, chief engineer of the railway, and chairman of the local entertainment committee, presided at the dinner. During the latter part of the dinner toasts were proposed and responded to, and patriotic and other songs sung and accepted with vim. The party boarded the special train again at 9.30, and arrived next morning in Ottawa, thus closing what everyone said was the most pleasant summer meeting of the Canadian Society of Civil Engineers.

The winter sessions of the Canadian Society of Civil Engineers begin with a meeting on the evening of 11th inst., at which a paper on the Carillon canal, dam and slide by Ernest Marceau, C.E., will be read. The society is now fairly installed in its new quarters, 877 Dorchester street, Montreal.

The Engineers' Club of Toronto expects to move into its new club rooms King street west, in November.

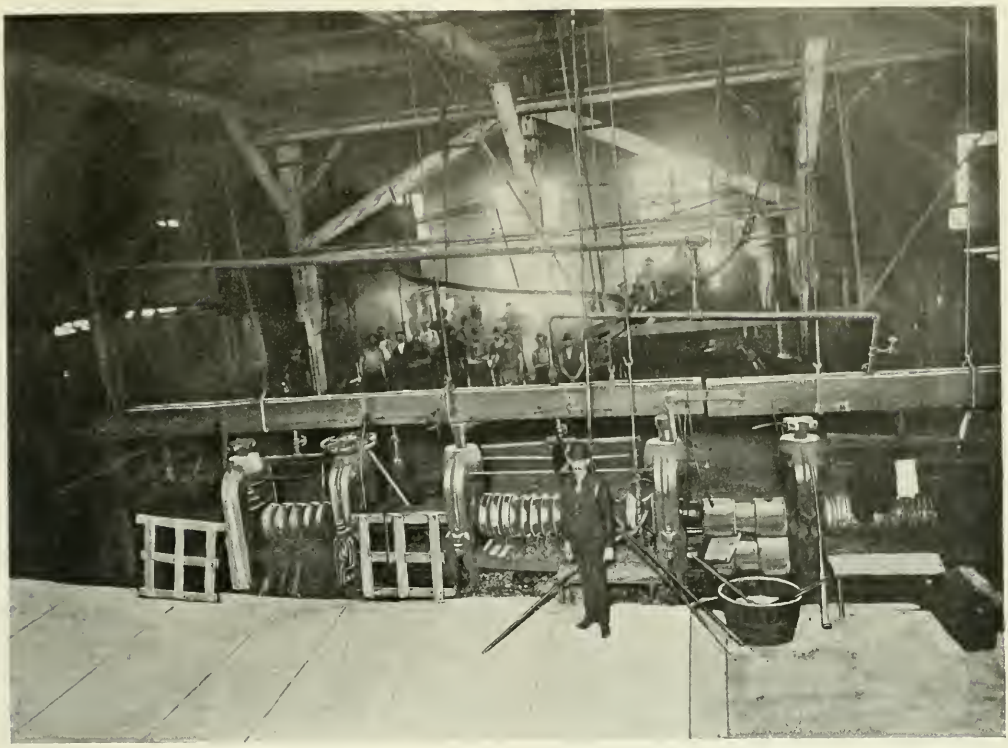
ABBOTT-MITCHELL IRON AND STEEL CO.

The Abbott-Mitchell Iron and Steel Co., of Ontario, Ltd., whose new works at Belleville have been briefly noticed in this journal from time to time, embodies in one corporation the plant and goodwill of three well known iron firms, viz., the Thames Iron Works of Norwich, Conn., the Metropolitan Rolling Mills of Abbott & Co., Montreal, and a rolling mill of Nashua, N.H. To these plants has been added other machinery which makes the new works at Belleville a very complete and up-to-date establishment. Building operations were commenced in August, 1899, and the rolls were started in January last. Since the inception of these, the most important new industrial works in central Ontario, the city of Belleville has taken a new lease of life. The former stagnation of the town has given place to bustling activity, and every department of local trade and industry has felt fresh energy as the direct result of the establishment of these large works, which have been well planned for the extensions which we trust the future of the iron trade will ensure for them. The buildings cover six acres, and the company owns altogether twelve acres of land, while it has ample land on the water front, where facilities for shipping by water as well as by rail are all that can be needed. A spur line from the Grand Trunk enables cars to be loaded directly at any of the company's warehouses or mills, while raw material can be laid down at the doors by three branch tracks from either vessels or trains. The principal buildings are the rolling mills, 153 x 321 feet; the nail and spike factory, 53 x 266 feet; the bar iron warehouse, 45 x 85 feet; the nail and spike warehouse, 53 x 125, and the offices, 25 x 40 feet and two stories. The various departments and buildings are so related to each other as to require the least rehandling of materials, and afford the quickest transfer from one stage to the other, till the completed goods find their way to the warehouse for shipment. The establishment in this respect is not surpassed by any concern of its size on the continent. The rolling mill has three trains of rolls—a 9-inch, a 12-inch and an 18 inch train—the largest of which produces merchant iron of the largest sizes required in the trade. One of the rolls produces nail plate and muck bars at the same time; and each train of rolls is served by a separate engine, so that the disabling, or stoppage for any cause, of one train does not affect the work of the others.

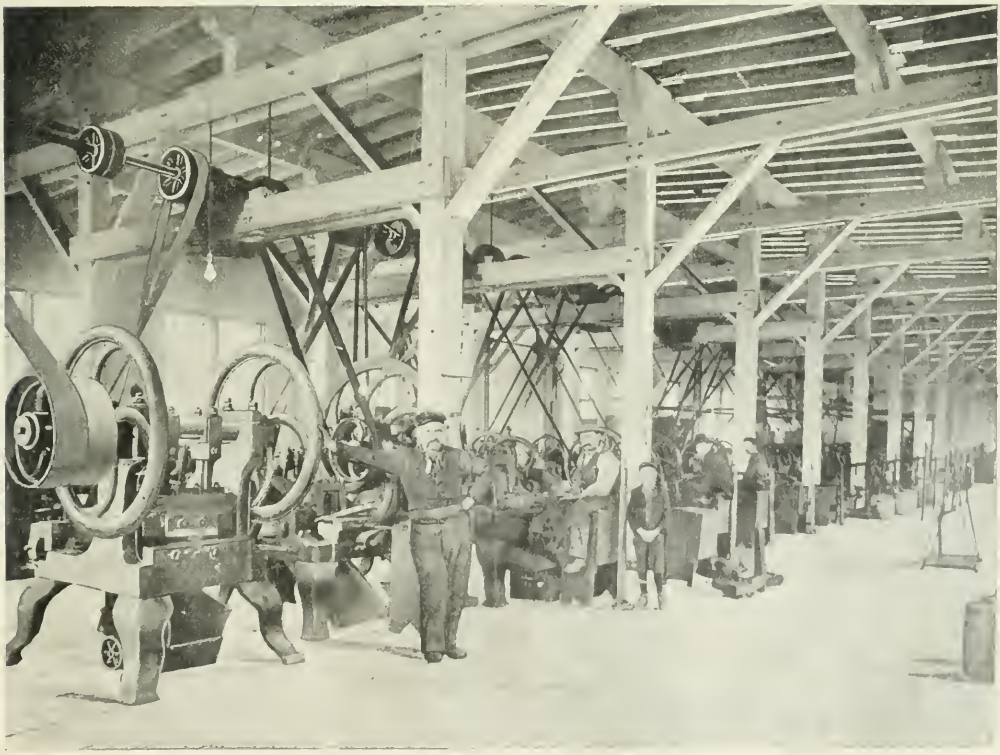


General View of Abbott-Mitchell Iron and Steel Co.'s Works, Belleville.

One of the engines is of 300 h.p. with an 18 foot fly wheel, and another about the same power There are eight furnaces in operation; and a power house for factory purposes contains a Corliss automatic engine, which besides supplying power, operates an electric lighting plant for the whole works, one dynamo running arc lights for the mills, and another incandescent lights for the offices and other departments The nail factory has 40 nail machines with a capacity of from 100 to 200 kegs per day.



12-Inch Rolling Mill—Abbott-Mitchell Iron and Steel Co., Belleville.



Nail Factory—Abbott-Mitchell Iron and Steel Co., Belleville.

The railway spike department has special machinery, with a large capacity. The special products of the works are bar iron and bar steel, including iron for structural work and agricultural implements, for car and engine building, bridge rods, bolts and spikes, railway spikes, track bolts; cut nails and horse-shoe nails, nuts (hot pressed), washers, etc. The establishment has been very busy since it began operations, and its products now find their way to all parts of the Dominion.

The directors of the Abbott-Mitchell Iron and Steel Co. are: Frank A. Mitchell, Wm. Abbott, Henry Pringle, John Mitchell, Charles Bard, S. S. Lazier and F. H. Camp. The first named gentleman, who is managing-director, brings to the business a thorough knowledge of rolling mill work, for he represents the third generation in his family who have made this their life occupation. He was for several years manager of the well-known mills at Norwich, Conn., and has been familiar with the business from a boy. Mr. Abbott, as is well known, is a son of the late Sir John Abbott, and has had years of experience in the old established rolling mills of Abbott & Co., Montreal, the products of which have been widely and favorably known throughout Canada. The superintendent of works is Chas. Mitchell, who for years managed the Syracuse Iron Works and Thames Iron Works, Norwich, Conn. The works started at Belleville with a capital of $150,000, but the increased business which came to the company, necessitating their operation day and night, has rendered an increase desirable, and the capital stock has been raised to $250,000. We understand some of this new stock can now be obtained by investors.

BROWN AND SHARPE.

The business of the world famous tool makers, Brown & Sharpe Mnfg. Co., was begun in 1833, by David Brown and his son J. R. Brown. David Brown retired in 1841, and the business was continued by J. R. Brown till 1853, when Lucien Sharpe became his partner, and the firm of J. R. Brown & Sharpe was formed. In 1868 it was incorporated as Brown & Sharpe Mnfg. Co. In 1853, twenty years after the founding of the business, although, as the company states, it had in the meantime earned the reputation for producing the best and most accurate work, the total floor space was only 1,800 square feet; in 1857 the total force consisted of twenty men. A large part of the time was then devoted to watch repairing and the making of small tools for jewelers' use. From 1859 growth as a manufacturing concern was rapid, and the buildings, never well suited to the purpose, became crowded. In 1872 there were more than 300 men employed and a move to the present location was decided upon. The plant has continued to grow until the present buildings, which are said to be among the best in America for this line of business, have a floor space of about seven acres, and more than 2,000 men are employed. There is in course of erection a new building, five stories high, with a floor space of 1½ acres (62.7 ares), that will be completed this fall. This building will have accommodation for about 500 workmen.

The following figures are of interest, showing as they do the increase of floor space and the number of men employed from time to time, and suggest the rapid growth of the business: Floor space of buildings, 1853, 1,800 sq. ft.; 1873, 0,000 sq. ft.; 1883, 115,200 sq ft.; 1890, 167,000 sq. ft.; 1900, 293,700 sq ft. Men employed: 1857, 20; 1872, 300; 1884, 450; 1893, 1,000; 1900, 2,000.

WHITE METAL.

The development of power is largely the problem of overcoming friction. Friction is the resistance caused by two bodies in moving contact with each other. It is dependent upon the area in contact, the pressure and the smoothness or otherwise of the surface. To engineers especially the question of the undue development of friction in bearings becomes of the utmost importance. It is usually solved by using a soft metal whose yielding surface is kept smooth by the very friction which it does so much to obviate. Reducing friction to a minimum has long been a problem to engine builders; and hitherto the so-called "white alloys" have, it is claimed, solved this problem with satisfactory results, especially the compound that have a large proportion of tin and the frictional coefficients of which are stated to be less than those of red brass, bronze, gun metal, etc., formerly used exclusively. White metal is not only a substitute for red brass, etc., but the makers claim it is preferable to copper alloys, because a proper white metal is more durable (it will never cut the journal), much cheaper (the working expenses being less) and the services rendered vastly superior, as the coefficients of friction are much lower; and that most of the European railway companies are now using white metal. The casting of white metals is attended with many advantages. The molten metal may be poured in direct, and there is a saving in the cost of patterns and moulds. The metal surrounds the shaft itself, and the pressure is uniformly distributed throughout the cavities of the pedestal. A pedestal or plummer block shell poured with white metal in this way fits faultlessly, and can be kept in use for a very long time. Worn-out white-metal bushes are also made fit for use again by melting and pouring. Some alloys possess extraordinary low coefficients of friction when being used for high speed, while at a low pressure and slow speed, they are far too high. To get the best results, engineers must choose the proper alloy for each purpose. The Tandem Smelting Syndicate, Ltd., London, Eng., who are represented by Lamplough & McNaughton, Montreal, makes three grades, A, B and C. Tandem A metal will stand about 25 per cent. more pressure than B and C. This alloy is, therefore, for many purposes, preferable to B and C, though the coefficients of friction of the latter are lower than that of the A quality. For the big wheel at Earl's Court, C quality was first tried, but it was found deficient in hardness, moreover, it was not tough enough; then Tandem A was adopted, which has given excellent results, it is said. Though the coefficient of friction of C is lower than that of A, the A metal was found to be superior for this particular case.

SPEED AND COAL CONSUMPTION OF THE TURBINE OF THE "COBRA."

A cable despatch says that the torpedo boat destroyer "Viper's" record of 43 miles an hour has already been surpassed by the "Cobra." The latter was built by the Armstrongs and is an exact duplicate of the "Viper," which was built by Hawthorne, Leslie & Co., at their works at Newcastle. Both have the Parsons turbine engines. The contract speed of each was 34 knots. The "Viper" did 37.113 knots on July 13. The "Cobra," in an unofficial trial over the same course at the mouth of the Tyne the other day, made 37.7 knots, or 43.5 miles. Her engineers say that she has not yet done her best, and that they expect fully another knot. The admiralty has now taken over the "Cobra" and an official test will shortly be made.

The efficiency of the steam turbine motor for the propulsion of such craft as torpedo boat destroyers has been amply demonstrated, says Engineering, London, first with the little "Turbinia," and more particularly by the "Viper," which has passed through her official steam trials under the direction of the British admiralty with pronounced success in every respect, attaining on a three-hours' trial the satisfactory speed of 33.838 knots. There are eight propellors. More could probably have been done, but this more than satisfied the contract conditions. The only point remaining to settle had reference to the economy of the steam turbine in comparison with the reciprocating engine; and the results are now available. As the power developed could not be determined, the only measure for fair comparison is the consumption per hour for a given speed. On a three-hours" trial at 31.118 knots the "Viper" burned 8.86 tons of coal per hour, or 10,846 lbs.; and on a three-hours' trial at 33.838 knots the consumption was 11 tons, 0 cwt., 1 qr., 1 lb., or 25,685 lbs. per hour. The "Albatross," which was built and engined by Messrs. Thornycroft, is the only destroyer with reciprocating engines which has on official trials made a speed approaching to that of the "Viper," and here the speed was 31.552 knots, with the engines indicating 7,732-h.p. The displacement of the "Albatross" is 384½ tons, and of the "Viper" 385 tons; while the coal consumed per hour for 31.552 knots for the former was 17,474 lbs., and for 31.118 knots of the latter 10,846 lbs per hour. A basis of comparison which requires no comment

VENTILATION AND HEATING.*

BY W. B. SNOW.

(Concluded from August issue).

The apparatus placed in the basement, near the centre of the building, discharges the air into a duct, usually quadrant in form, running along one side of the building, and communicating with the bases of the flues. These flues are generally of the construction shown in the detail, Fig. 9, and add but little to the cost of the building. Each opening or outlet is provided with a special form of damper, which serves the double purpose of deflecting the air toward the room when open, and of preventing admission when closed.

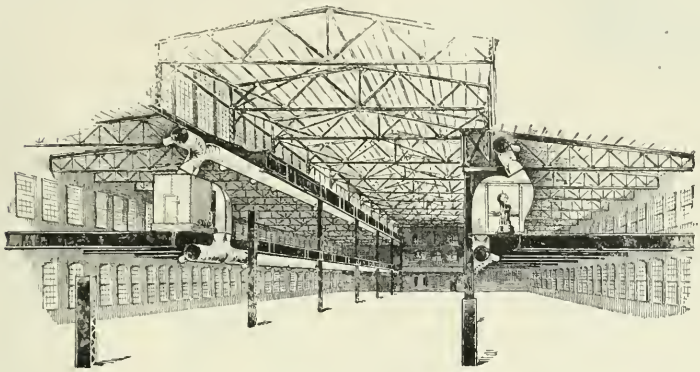


FIG. 8.

The large amount of moving machinery, pulleys, shafting and belts in such a building serves to thoroughly break up all air currents and effectually distribute the air. The equality of temperature maintained is evidenced by the accompanying average results and readings taken at random from a record kept at the West weave shed of the Pacific Mills, Lawrence, Mass. The mill was 180 feet long and 70 feet wide. The west end was entirely exposed to the sweeping winds from the Merrimac River, while the east end contained the lighting plant and heating apparatus. The openings for air admission were only five in number, on each floor, placed along the south side of the mill, and aggregating 3 37 square inches area per 1,000 cubic feet of space.

An important advantage of the blower system in the textile mill lies in the opportunity presented for moistening the air so as to offset

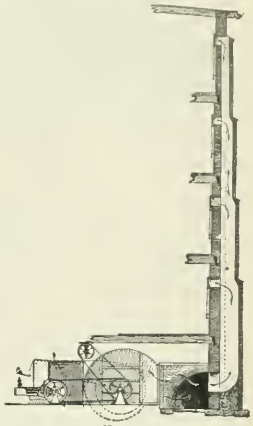


FIG. 9

TEMPERATURE AND HUMIDITY IN WEST WEAVE SHED, PACIFIC MILLS' LAWRENCE, MASS.

DATE.	Time.	TEMPERATURE. East End.	Middle. Floor.	Middle. Head High.	Middle. Ceiling.	West End.	HUMIDITY.
1889		Degrees	Degrees	Degrees	Degrees	Degrees	Per cent
Feb. 7	9 15 a.m.	70	70	70	71	68	65
Feb. 7	1 15 p.m.	68	69	68	70	66	64
Feb. 7	6.15 p m.	70	71	71	72	66	66
Feb. 8	6.45 a m.	70	69	71	73	66	61
Feb. 8	2 45 p m.	73	74	75	76	72	68
Feb. 9	7 25 a m.	70	69	71	72	66	75
Feb. 11	10.30 a m.	68	68	69	68	68	75
Feb. 11	5 30 p.m.	72	72	73	72	69	63
Average...		70.12	70.25	72.25	71.75	67.64	67.12

COMPARATIVE COST AND RUNNING EXPENSES FOR HEATING, VENTILATING AND MOISTENING SYSTEMS, GLOBE YARN MILLS, NOS 1 AND 2, FROM OCT. 15, 1888, TO MARCH 15, 1889.

Cost of Introduction.	No 1.†	No. 2.‡
First cost heating and moistening system....	$4,600 00	....
First cost heating, ventilating and moistening system	.....	$4,000 00
Cubic contents, cubic feet.....	1,103,852	1,316,520
Average temperature.....	70°	78°
Cost of system per 1,000 cubic feet	$4 17	$3 04
Ratio	100	73
	137	100
Running Expenses.		
Coal burned for heating	317,100 lbs	.....
Coal burned for moistening.....	58,500 lbs.	.....
Coal burned for both heating and moistening	375,600 lbs	.....
Coal burned for heating, ventilating and moistening	.. ...	286,900 lbs.
Coal burned per 1,000 cubic feet	340.26 lbs	217.92 lbs
Ratio	100	64
	156	100

*A paper read before the Applied Science Society of McGill University, session 1889-1900.

†Overhead direct radiation and Garland moistening system.

‡Sturtevant System of heating, ventilating and moistening.

the serious effect of the frictional electricity generated by the motion of belts, pulleys, running stock and machinery. In a direct heated mill the moistening arrangements are frequently very expensive. An interesting comparison of first costs and running expenses in two nearly identical mills belonging to the same corporation is here presented: Mill No. 1 was heated by direct radiation, and a complete independent moistening system was introduced. In Mill No. 2 the blower system was installed for the combined purposes of heating, ventilating and moistening. The cubic contents of the latter building was the greater, as was also the exposure Nevertheless, the first cost of the system per 1 000 cubic feet was only 73 per cent. of that in the No. 1 mill, while the temperature maintained was much higher, with a fuel expenditure of only 64 per cent of that required in Mill No. 1. Although the air supply was taken from the buildiog, the natural leakage was so great as to provide ample ventilation.

In all the buildings thus far presented, the ventilation has been of secondary importance, but in a large class of structures, more or less public in their character, such as schools, churches, theatres and halls, where the occupants are more or less closely seated, the per capita space is relatively small, and the vitiation by respiration proportionately great. The animal heat of the occupants has a material effect in warming the room, and in a building like a theatre, which has practically no exposed walls, the problem of artificial heating is thereby reduced to relative insignificance The ventilating problem, however, assumes correspondingly increased importance, and it becomes necessary to provide means of supplying air in large volumes properly tempered, admitted at such low velocity and in such location as to avoid all possibility of drafts. Positive means unaffected by atmospheric changes must be adopted. The fan blower is now generally recognized as the only device which will satisfactorily meet these requirements. Proper results can only be obtained when it is installed to operate on the plenum system by forcing the air into the building. It is then both convenient and necessary to heat the air in transit to the rooms, but inasmuch as the temperature and air supply requirements are likely to vary in the different rooms, some means more refined than is possible in factory heating must be employed for their proper regulation. Any one of three methods may be employed.

1. The air, properly tempered, may be admitted in constant volume and temperature regulation within the room secured by the use of direct radiators.

2. The air discharged from the fan at constant volume and temperature may be heated to any desired degree by supplementary steam coils placed within the supply ducts to the various rooms

3. The entire heating surface may be concentrated in connection with the fan operating at constant speed, and so arranged that the air discharged through it will be heated, while other air by-passed

round it still remains cool. A mixture of the warm and the cool air may then be made in any desired proportions to meet the exact requirements of the individual rooms. An apparatus arranged in this general manner is here presented in Fig. 10.

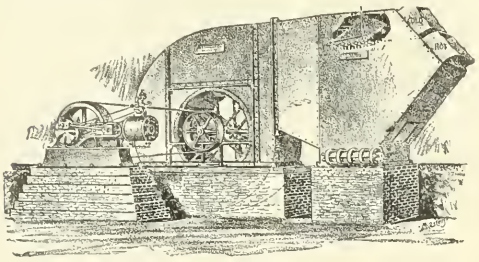


FIG. 10

From the hot and cold air outlets of such an apparatus separate ducts convey the air to the bases of the ventilating flues to the rooms. The flues are usually in the interior walls, and are provided with openings eight feet or more above the floor. From each outlet the air is discharged at low velocity toward the cold outer walls, where it becomes slightly cooled, falls, and passes with slow movement back across the bodies of the occupants to the vent opening, which is at the floor level in the interior wall next the supply flue. With this arrangement proper mixture of the warm and cool air at the flue base results from the operation of mixing dampers operated by hand or automatically controlled.

This system is familiarly known as the hot and cold system. As ordinarily installed, the hot air and the cold air connection with each mixing damper are of equal size, so that whether the air be hot or cold or a mixture of the two, its volume will remain constant. The maximum temperature of the warm air required in a system of this character may be taken at about 120 degrees.

Although carbon-dioxide or carbonic acid gas is the principal product of the respiration, it is by no means the most harmful. The true evil of a vitiated atmosphere lies in its other constituent gases and micro-organisms, which, however, are difficult of determination. Fortunately they preserve a fairly constant proportion to the amount of carbonic acid present. As this gas is readily determinable, its relative amount in a given volume of air is generally accepted as a measure of its purity.

Cubic feet of air containing 4 parts of Carbonic Acid in 10,000 supplied per person	Per Hour.	6,000	4,000	3,000	2,400	2,000	1,800	1,714	1,500	1,200	1,000	535	375	231
	Per Min.	100	66.6	50	40	33.3	30	28.6	25	20	16.6	9.1	6.2	3.8
Degree of vitiation of the air in the room.	Parts of Carbonic Acid in 10,000.	5	5.5	6	6.5	7	7.33	7.5	8	9	10	15	20	30

The figures indicate absolute relations under the stated conditions, and are generally applicable to the ventilation of schools, churches, halls of audience and the like, where the occupants are reasonably healthy and remain at rest. But the absolute air volume to be supplied cannot be specified with certainty in advance, without a thorough knowledge of all the conditions and modifying circumstances.

Assuming four parts of carbonic acid in 10,000 parts of air as the normal vitiation of the external atmosphere, and 6/10 of a cubic foot per hour as the amount of carbonic acid exhaled by an average person, we have the accompanying requirements regarding the air supply necessary to maintain a given standard of purity within an apartment.

A supply of 30 cubic feet per person per minute, by which, under these conditions, the degree of vitiation is maintained at 7.33 parts carbonic acid in 10,000 of air, has been very generally accepted as the minimum volume permissible for the requirements of what may be considered good ventilation. This marks the practical limit of the most successful systems where mechanical means are not employed. In point of fact the average for such systems is well below this amount.

Under good school room conditions with a space allowance of 250 cubic feet per occupant, a supply of 50 cubic feet per minute, or 3,000 cubic feet per hour per individual, appears to make the practicable limit of success for imperceptible admission of air. This is equivalent to changing the entire volume within the room once in five minutes. Increased volumes call for increased care in the manner of introduction, as evidenced in lower velocities and the greater extent of inlet openings. But when we consider that every child has a money value, represented by the expenditure necessary to develop him to his present physical and mental condition, and a potential value as a future wage earner, which death or physical decline will make a total loss, the business aspect of school-room ventilation becomes evident. Viewed from the financial standpoint alone, the actual cost of improved ventilation must be considered in its relation to the benefits derived therefrom. Obviously this cost must vary with the degree of ventilation, but the following figures from the reports of the School Committee on the City of Boston have sufficient relative importance to be conclusive. During the school year ending June 30, 1893, the total expenditure per pupil in the Boston public schools, exclusive of furniture, repairs and new school-houses, was $25.10. Of this amount 94½ cents was expended for fuel, so that the proportional cost of both heating and ventilating was only 3.75 per cent. of the total annual expense for the education of the child.

During the year covered by this report, the degree of air purity maintained in these schools was by no means up to the requirements of even fair ventilation. A conservative estimate would indicate that their heating alone might have been attained at an expense of about 82 cents per pupil. The ventilation, such as it was, and for the hours of occupancy only, therefore cost about 12½ cents per pupil for the entire year. Fair ventilation, secured by the supply of 30 cubic feet of air per minute per pupil, would have cost not over 33 cents per pupil, making the total cost about $1.15 per pupil for both ventilation and heating. The additional expenditure necessary to bring the Boston schools up to a uniform standard of fair ventilation would therefore have entailed an increased annual expense for fuel of only 20½ cents per pupil, or less than seven-eighths of one per cent. of the total annual expense of education.

Ordinary practice in school-room heating and ventilation, as exemplified in the illustration previously presented, limits the fan speed to that required to produce about one-half ounce, or ⅞ inch pressure, equivalent to a tip velocity of the wheel of about 3,600 feet per minute. Duct velocities will then range from 1,200 or 1,500 up to 2,000 feet per minute, flue velocities from 500 to 800 feet, and velocities of discharge to rooms from 300 to 400 feet.

All classes of buildings which may be properly included within the term "halls of audience," require substantially equal volumes of air to maintain equivalent degrees of purity, but their character, the per capita space and the arrangements for seating largely control the manner of admission of air. Where the seats are permanently fixed, and a plenum space can be provided beneath the floor, the air may be admitted therefrom through a multitude of small openings, thence pass upward across the persons of the occupants, and escape through ceiling openings. It thus becomes heated in transit, and in the case of an auditorium having little or no external exposure, must be admitted at a temperature measurably below that to be maintained within the room. A counter direction of movement is sometimes provided, the air discharged by the supply fan being admitted through a perforated ceiling and down through the floor by an auxiliary exhaust fan.

A church presents conditions peculiar to itself, for the per capita space is usually large, the heat transmission losses are excessive, the time of occupancy is slight, and the period of heating is frequently limited to a few hours on Sunday only. Although floor supply, subdivided for the individual pews, forms an ideal arrangement in such a building, it is frequently difficult of introduction, and usually expensive.

A simpler arrangement, decidedly effective in its application, consists in admitting the air through wall registers, supplied from a system of piping beneath the floor. The greater part escapes through ventilating registers at floor level.

One of the most complicated problems presented to the heating and ventilating engineer is that of the modern theatre. Consisting as it does of three principal parts, namely, the auditorium proper, the stage and dressing room, and the foyer, lobbies, stairways and connecting apartments, there is opportunity for constantly changing conditions as the performance progresses. It is seldom that the auditorium of a building of this character has any exposed walls. The effect of the occupants and of the lighting medium is therefore to increase the temperature to such an extent that the air must be admitted at a temperature below the normal, in order to maintain a comfortable standard.

Wall admission of air in large volume is therefore impracticable, for the cooler air tends to fall with disastrous results to the audience. Floor or ceiling supply presents the only successful solution. As a rule the former method is more readily and economically introduced.

The general method of primary distribution is as shown in the accompanying basement plan, Fig. 11. Air is drawn from the fresh air fan and forced by the fan into the circular space beneath the corridor, whence under pressure it passes beneath the auditorium seats. Each

chair is provided with latticed legs (see Fig. 12), to which air is admitted through holes in the floor immediately beneath. Individual supply is thus provided.

The conditions presented in a modern retail store are peculiar, in that the effect of constant passing through the doors is to admit large volumes of cold air, which very materially chill the adjacent portions of the store. This may be obviated to a very great extent by providing

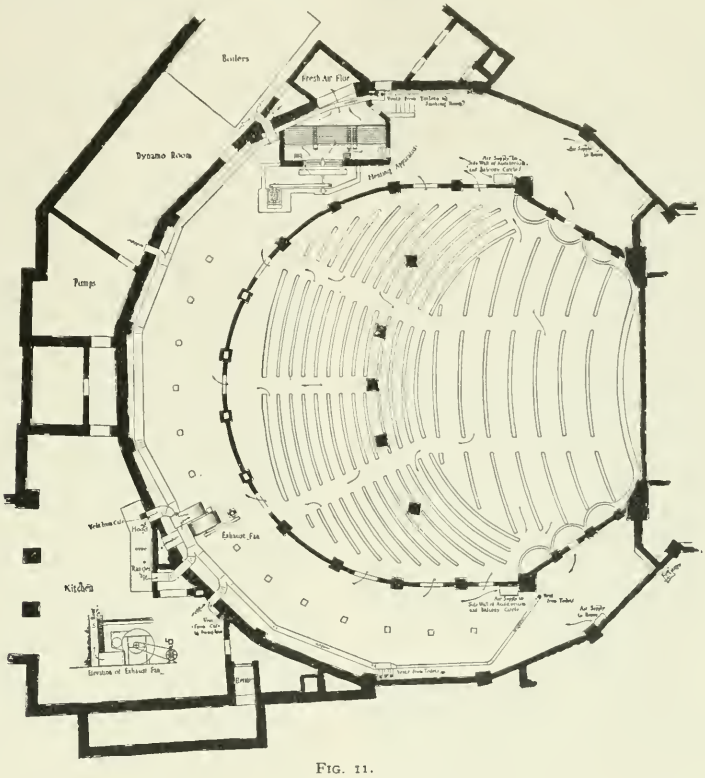


FIG. 11.

vestibules, which are kept thoroughly warmed by hot air supplied under pressure, so that all leakage is outward, and by introducing air at floor level beneath the counters, facing or near the doors.

The public at large is not slow to appreciate the material benefits of good ventilation, but its unsatisfactory experience with the movement of air by natural methods has almost led it to question whether good ventilation is attainable. Evidently positive means, acting independently of the weather, and capable of moving the required volumes, are absolutely necessary to success. The centrifugal fan best meets these conditions. It is furthermore a most important factor in the interdependent system which has been under discussion. The particular features of the combined system of ventilation and heating may be thus summarized. The entire heating surface is centrally located, enclosed in a fire-proof casing, and placed under the control of a single individual, thereby avoiding the possibility of change by

FIG. 12

leakage or freezing incident to a scattered system of steam piping and radiators. The heater itself is adapted for the use of either live or exhaust steam, and provision is made for utilizing the exhaust of the fan engine, thereby reducing its cost of operation to practically nothing. At all times simple and positive ventilation may be provided, with air tempered to the desired degree. Absolute control may be had over the quality and quantity of air supplied. It may be filtered and cleansed, heated or cooled, dried or moistened at will. By means of a hot and cold system the temperature of the air admitted to any given apartment may be instantly and radically changed without the employment of supplementary heating surface.

The pressure created within the building is sufficient to cause all leakage to be outward, preventing cold inward drafts and avoiding the possibility of drawing air from any polluting source within the building itself. By returning the air, using live steam in the heater and operating the fan at maximum speed, a building may be heated up with great rapidity, as is usually desirable in the morning. The area of heating surface is only one-third to one-fifth that required with direct radiation, while the primary cost and operating expense of a fan is far less than that of any other device for moving the same amount of air.

The system is essentially a necessity in buildings occupied as halls of audience, and may be readily introduced in the mill and the factory. The increasing extension of electric power and fuel gas distribution is making possible its application in all classes of buildings. Full appreciation of its advantages is therefore the best guarantee of its introduction.

IMPERIAL TRADE NOTES.

The following were among the enquiries relating to Canadian trade received at the office of the High Commissioner for Canada in London. Addresses can be furnished at this office: An English inventor of a patent chimney-pot designed to prevent down draught in every condition of wind, desires to hear from a Canadian manufacturer willing to take up and push the article in the Dominion. The manufacturers of umbrella component parts desire to hear from Canadian umbrella makers interested in the direct importation of such goods. A firm of oil, grease and varnish manufacturers, who have one or two special lines, desire to be placed in communication with

a good house in Canada willing to undertake their agency. A Canadian importer of button cloth (punched), and of button parts, i.e., shells and collets, wishes to correspond with English makers who would supply samples with a view to business. A London paper agent, who is about to visit Canada shortly, desires to hear of new paper and pulp mills not represented here, especially those able to produce large quantities of "news." The South African agent of a large firm of London general merchants, now in this country, is open to represent one or two first-class Canadian manufacturers willing to compete in South Africa. Preference given to such firms who would keep stocks in South Africa, and who have London connections. An English engineering firm whose specialty is pulsometers desire to hear from a responsible firm in Canada willing to act as agents. Parties desiring to embark in the pulp industry in the province of British Columbia are invited to communicate with a gentleman who is in a position to furnish useful information.

NEW CATALOGUES.

Magnesia Flexible Cement Roofing is the title of a catalogue sent us by the Philip Carey Mnfg. Co., Lockland, Hamilton Co., Ohio, U.S.

The 1900 catalogue of J. H. Williams & Co., Brooklyn, N.Y., contains an exterior and interior view of the company's works, which are finer than anything hitherto seen by us used in catalogue work, as they are engraved from wash drawings, not from photographs, as is usually the case.

The Morse Twist Drill Co.'s catalogue for 1900 is a very large and comprehensive publication. This flourishing and widely known company was incorporated in 1864. The company's works are in New Bedford, Mass., U.S.

The Jeffrey Mnfg. Co., Columbus, O., have issued a new catalogue of their chain belting, elevating and conveying machinery, which they have made a specialty. A copy of this catalogue will be sent on application.

LITERARY NOTES.

Current Advertising, published by Charles Austin Bates, Vanderbilt Building, New York, is a publication that many advertisers should read. The most important thing for an advertiser to know is what to do with the space he has bought.

The October Ladies' Home Journal will publish plans for the proposed enlargement of the White House, at Washington, and Colonel Theodore A. Bingham, U.S.A., custodian of the Executive Mansion, will urge their adoption in an article pointing out the need therefor. The obstacle that has stood in the way of enlarging the White House has been the fear of destroying the fine proportions and symmetry of the building. This has now been overcome by a skilled architect, whose solution of the problem will be given in the October Journal.

The Department of Public Works, St. John's, N.B., has published Sewerage and Water Supply, being the annual report of the engineer and superintendent for 1899. Maps and plans are given of the property bought at Spruce Lake, the reservoir, and the dam, and water mains there laid down. The real estate and riparian rights cost the city $43,560.

The Proceedings of the Royal Military College Club of Canada are issued in a red paper cover and contain some 200 pages. The proceedings of the 16th annual meeting and dinner and the report of the hon.-sec. treas. are followed by a large number of personal items relating to present whereabouts or recent promotions of various former members of the club. There are also a number of contributed papers, which are for the most part descriptions of battles in the South African war, written by graduates of the college, two of whom were subsequently killed in action.

The Journal of the Western Society of Engineers for August contains a paper on Reservoirs, and the control of the Lower Mississippi, which is followed by a written discussion, by L. E. Cooley, C. H. Tutton, R. E. McMath, J. Randolph and T. T. Johnston. This subject is one of the most interesting engineering problems on the continent.

The annual bulletin of the mineral resources of the State of Kansas, for 1899, has been published by the University Geological Survey, which is carried on by the Mining Department of the University of Kansas, under the authority of special legislation.

No. 57 of the publications of the British Fire Prevention Committee gives the results of some fire tests with treated wood which has been prepared by the London Non-Flammable Wood Co., Ltd.

The Michigan College of Mines has sent out a pamphlet consisting of full page views of the interiors of various departments in the college which is situated at Houghton, Mich., U.S.

The August issue of the Locomotive Fireman's Magazine is one of the most handsomely printed publications which has come to us for some time. It contains the report of the seventh annual convention. A series of comparative pictures shows the growth of the organization from a membership of 3,160 in 1881, to 36,084 in 1900.

The firm of Arthur Koppel, Ltd., Neue Friedrich street, Berlin, Germany, manufacturers of light railway equipment, have issued a very striking book of views of light tramways and electric and steam railways, built and equipped by the firm in various parts of the world. The descriptive matter accompanying, the cuts is printed in six languages, and the illuminated cover showing the forges by night is a fine piece of printing.

The work of moving the big printing press plant of The Ladies' Home Journal has begun, and within a month the manufacturing part of the magazine will be in its new home. There will be forty-five printing presses in the new seven-story building, and 17,600 square feet of floor space. The executive offices will all remain in the present large building, which covers four city lots. The entire plant is now the largest of any publishing house in America.

A few shrewd Canadians once made four millions of dollars clear profit out of building a small railway, of which most of us have never heard. The railway in question was the "Qu'Appelle, Long Lake and Saskatchewan Railway," which in 1887 received grants from the Dominion Government. The land granted to this company was sold for over $3,500,000, and from the sale of bonds and the cash subsidies the company got about $3,000,000 more, making a total of $6,500,000. The total cost of the road is estimated to have been not more than $2,500,000, leaving a net profit to the promoters of the road of four millions. The C.P.R. supplied the terminals and the rolling stock and leased the road without a rental, thus taking the railway off the hands of the original owners. This is one of the many railway stories which Mr. R. L. Richardson, M.P., is now telling in The Canadian Magazine in a series of four articles. Mr. Richardson believes in Government ownership of railways and is writing these articles in order to lay his views before the people of Canada.

Photometrical Measurements is a new book by W. M. Stine, Ph.D., which treats specially of the photometry of arc and incandescent lamps. As the thermometer measures the varying intensity of heat in different parts of a room, so the photometer measures light. Among the contents are also definitions of fundamental relations, practical unit of illuminating powers, practice of mean spherical intensity, elements of the photometer, and the various kinds in use are explained in a concise manner, as are also the photometer bench, and spectro-photometry. The spermaceti candle is described as the unit of light in England and America, as the paraffine is in Germany, and the carcel lamp in France. The arc standard of light is also treated on and the working value of light standard. The photometer room with its apparatus is described with the practise of incandescent and arc lamp photometry. The absorption of light by globes and the action of reflectors are also described. The book may be obtained from the publishers the Macmillan Publishing Co., 66 Fifth ave., New York; price, $1 60. Canadian agents, Tyrrell & Co., King street west, Toronto.

Newfoundland at last has its own literary magazine, and the first number issued in July will compare in quality of contents with any magazine published across the Gulf of St

Lawrence. It is called The Newfoundland Magazine, is published at St. John's, and edited by Theodore Roberts, a brother of Charles G. D. Roberts, the Canadian author. A sketch of Sir H. E. McCallum, the governor of the island, a description of St. John's, humorous pen-pictures of Newfoundland by Dr. D. W. Prowse; the Timber of Newfoundland, by C. M. White, and the French Shore Question, by Hon. E. P. Morris, are among its topics of current interest; while its poetry and fiction are above the average. The French shore question is very ably treated by Mr. Morris. This magazine is only $2 a year or 20 cents a number, and we strongly commend it to Canadian readers, who should know more about our nearest colonial neighbor, whose interests are so identified with our own.

Among the articles in the current number of the Imperial and Asiatic Quarterly Review, published at Woking, Eng., is a very suggestive one on the famine problem of India, and a strong "Plea for the Indians in South Africa," who have been most unfairly treated by the colonial governments, and shamefully outraged by the late Dutch republics. The heroism of the Indians who served as stretcher bearers in the Natal and Free State campaigns, should now be remembered, and the unjust legislation against them repealed throughout South Africa. Other instructive articles deal with the Referendum in Australia, with Corea, Morocco, the China situation, etc.

The Linotype Co., of Montreal, manufacturers of the Oliver typewriter, have issued a very attractive booklet giving the genesis of this very successful machine and quoting many strong testimonials from users. It is interesting to know that the Oliver typewriter is not only Canadian in manufacture, but in creation as well. Thomas Oliver, its inventor, was born in Oxford county, Ontario, and the interesting story of the evolution of the Oliver typewriter should be widely known as an example of what perseverance will accomplish.

The Statistical Year Book for 1899 has been issued by the Department of Agriculture from the Government Printing Bureau, Ottawa. Facts and statistics regarding the Government and constitution of Canada, its resources in agriculture, fisheries, minerals and manufactures, its commerce, its public works, its financial, insurance and other commercial institutions; statistics of education, population, temperance, crime, mortality, etc., are embodied in such a compact form as to make the work more useful than ever before. George Johnson, the Government's chief statistician, is a man born for his work. He knows by instinct just what new information is most valued, and how to present the developments of the country in an instructive way. He has the rare gift of making figures interesting; and the admirable order and system of his work enables him to make instant use of a vast mass of material, which was formerly "without form and void." Mr. Johnson is in fact the creator of a ready reference information department which is probably unequalled by any Government institution of the kind in the world.

In an instructive illustrated pamphlet on the "Wood Pulp of Canada," compiled by George Johnson, Dominion Statistician, an estimate is given of the available supply of pulp wood in this country. It is calculated that there are 450,000,000 acres of spruce wood in Canada, and taking 10 tons of ground pulp as the product per acre we have 4,500,000,000 tons of pulp in sight. In the province of Quebec alone it is estimated that there are 200,000,000 acres of wood land mostly timbered with black spruce, the most valuable of all woods for pulp and paper. Then the water powers as yet unutilized, and without which the manufacture of pulp and paper would be much handicapped, are enormous in the very regions where spruce most abounds. Canada is the premier land for spruce and paper.

—The United States consul at Dawson, reporting to his government last month on the Canadian Yukon, estimates the output of gold at $12,500,000, besides perhaps a quarter to half a million that went out unrecorded. Many owners will work their claims only during the cause of education, directly into the sluice boxes in which Sir William Macdonald dle the ground twice. Machi- trict; no one thinks now and pump.

Industrial Notes.

The bylaw for a $40,000 waterworks at Medicine Hat has been carried.

The Barrie, Ont., Tanning Co., whose works were recently burnt, are rebuilding on a large scale.

D. Hibner & Co. are erecting a brick addition with new dry kilns to their furniture factory at Berlin, Ont.

The Manitoba Milling Company, of Neepawa, is applying for incorporation. R. C. Ennis is one of the applicants.

The Strathcona Grain Cleaner Manufacturing Co., Strathcona, has been formed for the purpose of manufacturing a new grain cleaning machine.

The town of Lachine, Que., has obtained judgment against the Silver Shoe Co. and got possession of the property held as security for the bonus.

Egan and Edwards, who purchased the Hull Lumber Co.'s water power at Chaudiere Falls, purpose building a pulp mill of a capacity of 100 tons a day.

Siemens Bros. are building a factory at Wiarton at which tables will be made for home and export trade. The machinery will be operated by a Wheelock engine.

The management of the Chateau Frontenac, Quebec, owned by officials of the C.P.R., will enlarge the hotel for next season, it having been found too small this summer.

The Ottawa Car Company has sent to the British War Office a tender for the manufacture of transport wagons of a design that has done good service in South Africa.

President Shaughnessy, of the C.P.R., offers to erect a $1,000,000 hotel at Winnipeg, on certain conditions, one of which is that the city shall bear half the cost of a $60,000 subway.

The McCormick Mnfg. Co., and D. S. Perrin & Co., the confectionery manufacturing firms of London, Ont., are both throwing out their old engines and putting in new Wheelock engines.

Mr. Merritt, formerly of Smyth & Merritt, furniture manufacturers, is putting up a new factory at Strathroy for the manufacture of tables for export. A Wheelock engine has been ordered for the works.

The test of the new automobiles put in use for the Montreal postoffice shows a reduction of one-third of the time required in collecting the mail by the present wagon system. The test was a severe one, as it was applied on the mountain side and on muddy streets.

The Ham & Nott Mnfg. Co. will erect their factory at St. Catharines and not Brantford as previously reported. The company, which now has a capital of $50,000, is authorized by its charter to make spring beds, refrigerators, washing machines, and woven wire goods.

The Kingston News says the last locomotive works deal at Kingston is off again. Mackenzie and Mann have notified Mr. Reaves that they will not purchase the works. After an examination here a couple of weeks ago they were inclined to buy, as they felt it was a business venture of undoubted promise, but their other important operations have dissuaded them from adding to their responsibilities. Since the men have been paid off, W. King of the International Power Co., Providence, R. I., has secured a 30 days' option on the works at $75,000.

The Montreal Star reports that engineers have commenced work upon the Grande Decharge, Lake St. John district, for the new pulp and other mills that are to be erected by American capitalists at a cost of two to three million dollars. They will immediately construct a four grinder pulp mill on the banks of the Little Peribonca, at the White Falls. On the shores of the Mistassini and Rat Rivers colonization is advancing with rapid strides. The Trappists are farming and lumbering there on a very large scale, and furnishing employment to numbers of men. Several new roads and bridges are in course of construction through the rich agricultural lands of the district.

A rattan chair factory has been started at Sydney, N.S., by N. Reade.

The Dominion Iron and Steel Co., will erect a $30,000 hospital at Sydney.

London, Ont., is to build sewage filtration beds at the sewage farm, near the Coves.

Baker & Reid, of Winnipeg, are building a 25,000 bushel elevator, at Caron, Assiniboia.

The Almonte, Ont., Creamery Co. has bought a site, and will build the factory at once.

J. R. Booth has bought the McKay Milling Co.'s water-power at the Chaudiere, for $120,000.

Plans are ready for the new federal buildings at Rossland, B.C., which will cost about $65,000.

The Sewage Committee of the Fredericton, N.B., council report in favor of a new system of sewage.

Wm. McKenzie is again before the Gananoque council, asking a bonus of $10,000 for a furniture factory.

Quebec is to have a new theatre, to be built on the site of the old Academy, and to be finished about January next.

The first sod for the big elevators to be built by the Conners' Syndicate was turned at Montreal on the 2nd inst.

Reinhardt & Co., the Toronto brewers, are building a new brewery in Montreal to employ 200 hands and cost $200,000.

Geo. A. Proctor has the contract for the new public buildings at Sarnia, which are to cost $60,000, and to be started at once

The Skinner Co., Gananoque, have built a brass foundry, 60 x 30 feet, and propose to add a malleable iron foundry shortly.

The new extension to the works of the Toronto Bolt and Forging Co. (late Swansea Forging Co.), will be completed next month.

A Buffalo firm has approached the Welland council with a proposal to erect on the Welland Canal a factory for wooden tanks and boxes.

M. J. Haney, Toronto, has the contract for the bridge over the Hillsboro River near Charlottetown, P.E.I., the work to be completed within two years.

It is expected that the trains of the Ottawa and Gatineau railway will run over the new Interprovincial bridge at Ottawa by the end of November.

Kaslo, B.C., has decided to install a new waterworks to cost $1,300. The water will be drawn from Macdonald Creek by 1,000 feet of 6-inch pipe.

The Montreal Rolling Mills Co. have at length decided to establish works at Sydney, N.S., construction on which will be commenced this year.

The Robb Engineering Company, of Amherst, N.S., has presented a hot water boiler to the new science department of the University of New Brunswick.

The Aylmer, Ont., council will submit a bylaw for the erection of a waterworks system, and another for acquiring the Aylmer Electric Light Co.'s plant.

John A. McRae, contractor, Niagara Falls, Ont., is one of the promotors of the Niagara Falls Gas Co., chartered with a capital of $50,000, to supply gas to that town.

North Bay will vote on a bylaw to grant a $12,000 loan to a packing case company. The company propose to erect a building worth $25,000 and employ forty hands.

It is stated at Ottawa that Menier, of chocolate fame, will soon build two pulp mills on Anticosti, that island having 2,500,000 acres of spruce timber available.

The Metis Lumber Co. has bought the limits and saw mills of the Rimouski Lumber Co., and will have its headquarters at Grand Metis, Que., with a capital of $85,000.

The Algoma Pioneer says a party of engineers and men have begun work on the second water power canal, under the management of F. H. Clergue. This canal will yield 70,000-h.p.

Eddy Bros. & Co. is another Michigan lumber firm that has been obliged by the Ontario log law to move their mills over to Georgian Bay. They will erect mills at Blind River.

The London, Ont., Veneer Co., composed of Messrs. Fitzgerald, Craig, Scandrett and Forestal, are now equipping a factory for the manufacture of veneered boxes, chiefly for export.

The Cloverdale Milling Co. has been established at Cloverdale on the Great Northern Ry., 12 miles south of Westminster, B.C. The capital is $10,000, and the company will manufacture lumber and shingles.

Leitch & Turnbull, elevator manufacturers, Hamilton, have been incorporated with a capital of $40,000, the members being A. Leitch, W. G. Leitch, C. H. Thompson, James Turnbull and W. A. Turbayne, all of Hamilton.

The McLaughlin Automatic Air Brake Company will be organized to make the McLaughlin air brake. The capital will be one million dollars, and the headquarters will be either Windsor or Walkerville.

The back of the boiler makers' strike in Montreal has been broken by the return, on the 1st inst., of the men to some of the shops. The men, after being out since July 6th, have gone back at their old wages.

In a letter to the Mayor of Hamilton, John Patterson states that the Patterson Coal and Coke Co., of Penn., are about to erect 300 coke ovens at Hamilton, and will be able to supply tar and gas in large quantities.

The Engineering Contract Co., Quebec, is being wound up, Henry Holgate, C.E., the manager, being retained in charge till a liquidator is appointed on 3rd Nov. Mr. Holgate is authorized in the meantime to continue the contract with the Canadian Electric Light Co., at Chaudiere Falls.

The Hoepfner Refining Co., Hamilton, has leased its buildings and plant to the Nickel Copper Co. for 97 years, thus freezing out Dr. Carl Hoepfner. The latter company expects to fill orders for nickel and copper next month.

A beet root sugar factory is to be built in Prince Co., P.E.I., by an American company, which owns the two beet sugar factories in New York State. The works will cost $800,000, and employ 200 hands besides skilled operatives.

E. B. Douglas, president of the Sault Ste. Marie Pulp and Power Co., has been studying the water-power in the neighborhood of Fort William and Port Arthur. He may make a proposition to supply water and electric power to those towns.

C. F. Hodges is manager of the new Farmers' Co-operative Packing Co., at Brantford. Most of the machinery for this factory is supplied by Wm. R. Perrin & Co., of Toronto and Chicago, manufacturers of packing house machinery and supplies.

J. Fee, J. S. Smith, J. Robinson, F. E. Browne, W. J. Freeman, Montreal; R. B. Hutcheson, F. W. Hibbard, Westmount, are applying for incorporation as the Gas Appliance Mnfg. Co., Ltd., to manufacture gas heaters and appliances. Capital, $50,000; head office, Montreal.

Cowan & Co., Galt, the well-known manufacturers of wood working machinery and of the Dakin feed water heater, have opened a branch office in Montreal. It is on St. James street, near Victoria square, and is in charge of W. H. Fisher, who has been with the firm since 1882.

Geo. S. Wilson, of Montreal, secretary of a new company to be called the Quebec Pulp and Paper Co., proposes, on agreement with the Quebec city council, to build new mills on the site of the Reid paper mills at Indian Lorette, a dam being put across the outlet of Lake St. Charles.

R. H. Pope, M.P., Cookshire, Que; Geo. G. Foster, Montreal, Que.; G. Stevens, Waterloo, Que.; F. P. Buck, Sherbrooke, Que., and W. W. Bailey, Cookshire, are applying for incorporation as the Dominion Industrial Co., Ltd., to manufacture pulp and paper, and to acquire the Cookshire pulp mill. Capital, $200,000; head office, Sherbrooke, Que.

The Dominion Carpet Co., Ltd., is now the name of the Dominion Brussels Carpets, Tyrrell & Sherbrooke, Que., which has been taken over by [illegible]. The plant will be much enlarged [illegible] Wilton and tapestry and velvet carpets. [illegible] at last has its own literary [illegible]ital is £45,000. The directors [illegible]ny magazine published across the [illegible] Smith, W. M. Philip

A by-law to raise $28,000 for a new City Hall has been adopted by Hull, Que.

The American Bridge Co. is to establish a branch bridge building plant at Three Rivers, Que.

A demand of assignment has been made on Wm. Rodden & Co., iron founders, Montreal.

The Rat Portage Lumber Co., propose to erect a saw mill, employing 400 hands, and will locate in Winnipeg or St. Boniface.

The Victoria Foundry Company, of Ottawa, is erecting a new foundry to cost $15,000. It will be of brick, 164 x 84 feet, two stories.

John McDougall, Caledonian Iron Works, Montreal, will supply the pumping machinery, filter and storage tank for the new waterworks at Arnprior.

John McDonald & Co.'s wood working factory at Chatham, N.B., lately burnt, is being rebuilt. The machinery will be furnished by Cowan & Co., Galt.

W. P. Thomson, of Hamilton, has bought the Richmond, Que., water-power and industrial property at $100,000. Factories are to be erected at once, and will be exempt from taxes.

The case of the General Engineering Co., of Ontario, vs. the Dominion Cotton Mills Co. and the American Stoker Co. is before the Supreme Court this month on an appeal from the Exchequer Court. The case had not been decided at the date of going to press.

The boiler in James Chapman's saw mill at North Shore, Botsford, N.B., exploded the other day, scalding two men named Allen and Walton so badly that one of them may die. The machinery was destroyed.

Bylaws granting a loan of $5,000 to D. J. Shanahan to assist in enlarging his carriage factory, and exempting him from taxes; and granting P. Payette & Co. exemption from taxation on intended extension to their foundry and machine shops, were carried last month at Penetanguishene.

The new Waterous fire engine purchased by St. John, N.B., has passed a most satisfactory test, proving its superiority to the city's engines previously bought in the States. A number of engineers who came from neighboring towns to witness the test expressed their surprise at the work done by the new engine.

E. Bravender, formerly of the Napanee cement works, has a quarter interest in a new cement works to be built at Lakefield, Ont. The company is to get a bonus of $10,000 and a free site of 10 acres. The works will be run by electricity from a nearby water-power, and the capacity will be 600 barrels per day.

The Manitoba Union Mining Company, which has been working for some time on the erection of necessary buildings and machinery at the cement deposit near Miami on the Morris and Brandon branch of the Northern Pacific have the work so far advanced that they expect to commence shipping in about a month.—Winnipeg Commercial.

The Downer Pattern Works, 114½ Church street, Toronto, are working day and night to keep up with the demand for patterns for electrical, machine and waterworks contracts. Some of the largest contracts for patterns for machinery and electrical plants ever given in Canada have been successfully filled by these works.

C. H. Rust, city engineer of Toronto, warns the council that an accident to an engine or boiler of the waterworks would leave Toronto without water and without fire pressure. The boilers of two of the engines are very old, and one of them gave out recently. Two of the engines are running 24 hours a day and another badly needs repair. The cost of running three of the engines is very high, owing to the necessity of using hard coal, and the excess consumption of coal would provide interest and sinking fund for a new engine. Mr. Rust adds: "The average consumption of water per 24 hours for the last three or four months was 23,600,000 gallons. Nos. 4 and 5 engines are running at 10 [illegible] over their contract rate, which practice should be discontinued as soon as possible, as already the foundation of the engine for a [illegible] showing signs of weakness, and repairs to be made."

the cause of education which Sir William Macdonald put down

Railway Matters.

The Gilbert Plains branch of the Canadian Northern Ry. is now practically completed.

Surveys are being made for the new G.T.R. link from Brantford to Paris. A bridge will be needed.

The new I. C. R. round-house at Stellarton will cost $46,000, and will be built by Rhodes, Curry & Co., Amherst.

The first train passed over the new bridge of the Ottawa and New York Central Railway across the St. Lawrence on Saturday, Sept. 22nd.

The first stone in the bridge over the St. Lawrence at Quebec, was laid by Sir Wilfrid Laurier on the 2nd inst. A large staff of men is already engaged on the work.

The C.P.R. is surveying a new line from near Agincourt, Ont., east to Claremont, about 18 miles, to overcome the heavy grade on the present line, and also to reach the town of Markham.

A. I. Trueman, of St. John, has been elected president; A. B. Copp, of Point de Bute, vice-president, and J. McQueen, of Shediac, secretary of the new Shediac and Coast Ry. of New Brunswick.

The C.P.R. will construct a five span steel bridge over the Columbia river at Sproat's Landing, a few miles below Robson. At present the traffic is transferred across the river at Robson by ferry.

The Pontypool, Lindsay & Bobcaygeon Ry., for which W. T. Jennings, C.E., of Toronto, is consulting engineer, is being located, and construction will be commenced this fall under James McDougall, C.E., The road will be about 40 miles long.

It is stated that the Coast Railway Co. of Nova Scotia, now running from Yarmouth to Barrington Passage, a distance of 50 miles, will next year be built through to Halifax. There has been considerable tourist traffic over the road during the past summer.

The Strathroy & Western Counties Ry., running from St. Thomas to Strathroy and northwest, is now being located under the direction of W. T. Jennings, C.E., of Toronto, and construction will shortly be commenced. The line is about 50 miles in length.

The promoters of the proposed Ottawa, Brockville and St. Lawrence Ry. are having preliminary surveys made, by which the length of line from Ottawa to Brockville will be reduced to 57 miles. Bonuses are being sought from various municipalities affected, and if the Government bonus of $3,200 a mile is secured work will be commenced next summer.

At the annual meeting of the Quebec and New Brunswick Ry. Co., held at Quebec on Sept. 20th, the matter of further surveys was left in the hands of the engineer, E. A. Hoare and of Hon. John Costigan. Offers to construct the road have been received from — Malcolm, contractor; J. C. Brown, of Kent Northern Ry., N.B., and from Dini and Cazzolino, of Montreal.

In developing the iron mines of Michipicoten by the Algoma Central Ry., F. H. Clergue of Sault Ste. Marie is transporting from Chicago across the lakes two complete trains loaded on barges. They include two locomotives and tenders, two passenger cars and 48 freight cars, all set up ready to run on arrival at the harbor. The cars are built by the Pullman's, and the locomotives at the Baldwin works. James Conmee, M.P.P., has the contract for a 50-mile section of this road.

A new outlet for the products of the west will shortly be opened by the Great Northern Railway, connecting Ontario and the west with the Canadian seaboard. The Shawenegan Water & Power Co.'s works will be completed in the spring and with the different companies who have contracted to use their power the railway expects to do a business of 1,000 tons per day next summer. To provide for its export grain trade a million bushel elevator has been built at Quebec by the Great Northern at a cost of $300,000. A charter has also been granted the Chateauguay and Northern Ry. to build from Montreal to Joliette on the Great Northern, a distance of 36 miles, and also to build a bridge over Riviere des Prairies at Bout de l'Isle into Montreal.

Without question the most artistic souvenir ever issued by a Canadian company is that recently compiled by the Grand Trunk in commemoration of the opening of the Victoria Jubilee bridge. It is in the form of a book about 6 x 7 inches, printed on heavy calendared paper and containing photogravure or Albertype illustrations relating to the history of the bridge, such as a fac-simile of the invitation card to the inauguration of the bridge by the Prince of Wales in 1860, the medal struck on that occasion, pictures of the St. Lawrence and Atlantic Ry. station and ferry, 1855; of the old bridge and of the new one, with facts and figures relating to each. But the most striking feature is the beautifully chased aluminum cover, on the front of which is lithographed a view of the new bridge, while on the back is a view of the old tubular bridge. The author of the historical sketch, and the artists who did the printing, engraving and metal work modestly withhold their names, but their achievement commands our unstinted admiration.

Electric Flashes.

The Woodstock, Ont., Electric Light Co. will sell their plant to the town for $14,000, but the town offers $13,000.

Hamilton has gone back to gas for the lighting of the civic buildings, saving $375 a year on the city hall and clock tower alone.

The Western Telephone and Telegraph Co. will build lines through the Nelson and Slocan districts to connect the Boundary country with Vancouver.

The Packard Electric Co., St. Catharines, Ont., have placed on the market an ingenious wire lamp guard, made to open out so that they can be nested in packing.

Hinton Bros., agents of the Royal Electric Co., at Victoria, have been awarded the contract for a 950 h.p. motor and hoist at the LeRoi mine, Rossland. The price is $20,000.

Work is proceeding on the electric railway to run from Preston to Berlin, Waterloo and Port Dover, and it is expected that cars will be running by 1st January next on part of the system.

The Jones & Moore Electric Co. are installing two of their direct connected type dynamos with engines and all fittings complete for Messrs. Weddell & McAuliff, of Morrisburg. They are for lighting of two large dredges.

The Jones & Moore Electric Co. have received orders from the Bertram Engine Works Co., for 50-h.p. capacity of electric motors of their new type; and from F. Sandford & Co., Fenelon Falls, for a 500-volt generator and motor to operate their works.

The Newmarket town council has voted $10,000 towards the extension of the electric light plant, and has purchased a 250-h.p. Wheelock condensing engine, new boiler and 100-k.w. dynamo. This will give the plant a 3,000-light capacity. At present there are 1,700 lights run.

The Jones & Moore Electric Co. report among others, the following electric motor sales: H. W. Petric, 20-h.p., H. W. Hyman, Jas. Stewart, Challenger Leather Co., Palter & Cooper, Williams Box Co., W. Clark & Co., Ward & McKenzie, Crown Clothing Co., Toronto; Chas. Young and W. H. Moyer St Catharines; J. Deslauriers, Ottawa.

E. E. Cary and G. A. Powell, of St. Catharines; N. L. Henderson, contractor; S. F. Washington, barrister, and W. E. Boyd, merchants, of Hamilton, have been incorporated under the name of the Hamilton Electric Supply & Construction Co.; capital, $40,000; to deal in electrical supplies, and install electric plants, with head office at Hamilton.

The Packard Electric Co., St Catharines, have got out a very striking souvenir in the form of a perpetual calendar, mounted in a decorated aluminum frame, which also contains a small mercurial thermometer. It is a tasteful and useful desk appendage, and will be much appreciated by the customers of the company. It is issued as a memento of the tenth anniversary of the Canadian Electrical Association.

The city council of Kingston is getting ready to take over the electric light and gas plants. The company may make terms with the city as to the value of the plant, to save the costs of arbitration.

The Renfrew Electric Co., formerly A. A. Wright & Co., is improving its plant. A new Crocker turbine is being put in and foundations laid for the new dynamo. The company expects to furnish power, light and heat by 1st Nov.

John Patterson, on behalf of the Cataract Power Co., has made application to the townships of Barton, Saltfleet and Grimsby for right of way for a new electric railway from Hamilton to Grimsby, as a rival to the present H. G. & B. railway.

The business of Macdonald Bros., electricians, Winnipeg, is being taken over by a joint-stock company, under the name of the Electric Supply and Manufacturing Company and Macdonald Bros., Ltd. The company will occupy new premises at No. 565 Main street.—Commercial.

L. J. Marien, superintendent of the Montreal waterworks, recommends the installation of two electric pumps at a cost of about $30,000. They would be capable of pumping five million gallons per day. The water committee have decided to call for tenders from either Canadian or American firms.

F. P. Brothers, manager of the Demerara Electric Company, of which Sir William Van Horne is president, has returned to Montreal from Georgetown, British Guiana, where he has been superintending the building of the street railway. This company has built twelve miles of street railway, and controls the whole electric plant of Georgetown.

The Berlin, Ont., Furniture Co. have placed an order with the Electrical Construction Co., of London, Ltd., for a 150-light multipolar dynamo to be installed in their new factory. This company is also supplying a 600-light generator to, and doing the complete wiring of, the new buildings of the McLaughlin Carriage Co., Oshawa, Ont.; and a 75-light multipolar dynamo to the Jackson-Cochrane Co., Berlin, Ont.

Although the summer is usually a poor season for the arc lamp business the Manhattan General Construction Co., of Newark, N.J., have been busier than for the past seven seasons. The Manhattan "series A.C." system appears to be rapidly coming into use throughout the United States, and among recent Canadian orders is one from the Hamilton Electric Light and Power Co., for 200 arc lamps.

The council of Kildonan, Man., has already granted right of way to the Winnipeg, Selkirk and Lake Winnipeg Electric Ry., but the councils of St. Paul's and St. Andrew's, which lie between Kildonan and Selkirk, have granted the right of way to the Selkirk Electric Ry., an opposition scheme. Unless an agreement is reached to give both companies the right of way the construction of either road may be delayed.

The Canadian General Electric Co. have acquired the entire stock of the Canada Foundry Co., of Toronto. The foundry business will, however, be carried on without change of name, and on the same lines as at present. The control of these works will give the Canadian General Electric Co. special facilities for the manufacture of iron work required in filling large orders for electrical machinery.

The Electrical Construction Co., of London, Ltd., report the following sales during the past month: Ness, McLaren & Bate, Montreal, one 5-h.p. B.P. motor; Oram & Carter, Kingston, one 8-h.p., B.P., motor; L. Allcock, Sault Ste. Marie, one 5-h.p., bipolar motor; the Rehder Plating Mnfg. Co., Thorold, Ont., one 12-h.p. motor; G. E. Matthews, Montreal, three machines of different sizes. They have also received orders from their Winnipeg agents for one 15 h.p. multipolar motor, one 16-h.p. multipolar motor, and one 8 h.p. bipolar motor.

A special committee of the Toronto city council has warmly recommended the adoption of an automatic system of telephones, and the operation of the system as a municipal institution. It was shown that a great saving could be effected over the prices paid to the Bell T[illegible] Co. The city engineer calculated that while [illegible]nts, Tyrrell [illegible] business phones, and $18 for priva[illegible]ot Bell Telephone charges of [illegible]d at last has its own literary [illegible]ll be effected of $71,000 a [illegible]er issued in July will compare in q[illegible]omatic system, which [illegible]ny magazine published across the [illegible], Ohio, and

which is the invention of a Canadian—Mr. Lorimer, a former citizen of Brantford—would be still cheaper, it is claimed. The council has taken no action yet.

For unexpected developments, downright hard luck, continued bungling, and amusing incidents Orillia's power scheme "takes the cake." Nothing to equal it in the way of a variety show has ever before "struck town." This week there has been a fresh crop of episodes. Shortly after Mr. Patriarche had purchased the steamer "Queen" and brought her from Sutton to Orillia, Constable Dreyer received instructions to put the boat under arrest until a claim for wages against her previous owner should be settled. This the constable proceeded to do by tying the steamer to the wharf, and nailing the warrant for her arrest on a prominent part, in default of a mast. Meantime Mr. Patriarche was allowed to go on with repairing the boat. When she was supposed to be ready for sea, Mr. Patriarche communicated with her previous owner, and learned that the claim for wages had been satisfied. He then wanted to take the "Queen" away, but Constable Dreyer would not permit it, until he heard from the Admiralty Court. However, in spite of protests, Mr. Patriarche determined to have his boat, and started down the lake towards Washago with her. The repairs to the hull, however, proved inadequate, and she leaked so badly that in spite of vigorous bailing, she arrived at Washago in a half sinking condition, and on being beached near the railway bridge, settled to the bottom. Meantime, when Constable Dreyer found that Mr. Patriarche had taken the bit in his teeth, he was much annoyed, and immediately swore out a warrant for his arrest on a charge of "stealing the steamer 'Queen.'"—Orillia Packet.

Mining Matters.

The Calabogie Mining Co. has a contract to supply 10,000 tons of ore to the Midland Furnace Co., Midland, Ont.

The British American Corporation will install a 40-drill compressor plant in its Great Western mines, Rossland camp.

Men are now at work opening up several iron properties on Sarita, Toquart and Copper island on the west coast of British Columbia.

The marble quarries of the Bras d'Or Marble Co., Marble Fountain, C.B., have been bought by the Dominion Iron and Steel Co., for $80,000.

J. P. Williams will install machinery to increase the output of the graphite mines, near Grenville, Que. The ore will be shipped to Pennsylvania.

Around Kamloops lake there are quicksilver deposits, which have been traced for nearly 45 miles, it is said, and the indications are favorable to the existence of large finds.

The Rossland Miner reports that on the Old Gold property, a strike has been made of two feet of solid ore carrying values of $100 a ton, and three feet of concentrating ore.

Miners returning from the headwaters of the White river, Yukon, say the placer-copper areas in that region are the richest they have seen, and would warrant the building of a railway there.

During Aug., on the Ymir mine, Ymir, B.C., 4,650 tons of ore were milled, producing 298 tons of concentrates, and 2,340 ozs. of bullion. The profits for the month amounted to $25,550.

The discovery of large bodies of iron ore on Big Sand Creek, East Kootenay, is reported, the ore carrying 60 per cent. iron and $4 gold. The vein has been traced for four miles.

A strike has been made on the Rico, Sandon, B.C., showing three inches of clean galena of the same character as that shipped from this mine two years ago, which was the highest grade galena ore ever mined in America.

The ten surveying [illegible] North Ontario by the Crown Lands Depar[illegible] turn. They find that the districts [illegible] have large tracts of fertile [illegible] to enable them to do

William C. Macdonald
to the cause of education

The Belmont gold mine, near Marmora, Ont., is closing down.

The Hamilton Steel and Iron Co. is now drawing much of its ores from the Michipicoten district.

A large body of ore was recently discovered at Fernie, B.C., the ledge of which is said to be 27 feet wide.

The Standard Copper Co. is about to build a smelter at Boundary Falls, about four miles from Midway, B.C.

The British Columbia Government includes $2,500 in this year's estimates for a School of Mines in Rossland

A flow of natural gas has been struck on the farm of Mrs. William Gankle, near Lynden, in the vicinity of Brantford, Ont.

Near Lornevale, not far from Acadia Mines, N.S., quantities of iron ore have been discovered, as rich as the ore of Londonderry.

Work has commenced on the property of the Cowan Coal Co., situated at the eastern end of the Crow's Nest Pass. Present indications show that the deposit is a remarkably good one.

The Cataraqui Mining and Development Co. has been incorporated; capital, $400,000; directors, Hon. Peter Maclaren, Hon. Donald McMillan, and others; place of business, Kingston, Ont.

J. Kleinsteuber, of the German settlement, near Tweed, has brought to the Belleville assay office samples of copper ore running $90 to the ton. This is the richest yet tested in Eastern Ontario.

The Ontario Government assay office, at Belleville, had a very busy time during August, having assayed 162 samples, and received many enquiries from firms interested in various minerals of Ontario.

B. W. Folger, of Kingston; James Hammond, of Fort William; J. P. McMillan, W. K. Gibson, and H. J. Dawson, of Petrolea, have formed a company called the Tip Top Copper Co., of Ont., capital, $1,000,000; head office, Toronto; to carry on mining operations.

J. W. Bain reports to the Ontario Bureau of Mines, the discovery, on the eastern side of Lake Nepigon, near Sturgeon river, of a large body of iron ore. The ore is hematite banded with jasper. It is 100 feet wide, and extends over several miles.

The Wiarton Oil and Gas Co. has been formed at Wiarton with a capital of $20,000. John Caldwell, G. E. Willits and E. P. Rowe, of Hepworth, and James Hunter, J. T. Crawford, W. G. Towle, and W. H. B. Spotton, of Wiarton, are promoters. The company, while boring for oil near Hepworth, struck gas with a pressure of 240 lbs., at a depth of 1,600 feet.

The barytes mines, near River John, at one time owned by the late Mr. Pendergrast, of Truro, are being opened by a New York firm, who expects to be shipping in a few weeks. D. J. Patrick, of New York, formerly of Nova Scotia, is superintending the work.—New Glasgow Chronicle.

O. R. Sprague, mining expert, has lately been prospecting through the Ames' property in Storrington township, Frontenac Co., Ont., where a large deposit of magnetic ore was found. Galena veins are also noticeable to a great extent. Two portable engines will be shipped to the property, and a force of men put to work at once.

A despatch says that R. H. Ahn, manager of the Crown Point mine, has brought into Rat Portage a gold brick made from a trial run in the new mill, which was very satisfactory. Some thirty men are employed on the property. A fire recently destroyed the shaft house, but the energetic manager soon got the debris cleared away and the machinery repaired and under cover. The Crown Point is on the Mikado contact, and has a system of veins, from which some very rich ore has been taken.

The "Sakoose," gold mine, in the Rainy River district, has been bought for $275,000 by the Ottawa Gold Milling & Mining Co., whose directors are: Hon. G. E. Foster, J. Coates, president Ottawa Gas Co.; D. Murphy, president Ottawa Transportation Co.; George Hay, vice-president Bank of Ottawa; E. P. Bronson, of the Bronson Co.; R. A. Mather, Keewatin Lumber Company. The company owns a 6,000 h.p. water-power at Keewatin, where the Lake of the Woods empties into the Winnipeg river.

Four men were injured in the Le Roi mine, Rossland, B.C., Sept. 14th, by the falling of the skip from the 800-ft. level, below which the miners were working.

The James Cooper Manufacturing Company, of Montreal, have closed a contract with the Crow's Nest Pass Coal Company for the equipment of their mines, at Fernie, the plant to consist of a 26 x 30 straight line, Ingersoll-Sergeant compressor and 10 coal cutting machines of the new model, with all accessories. This compressor is the largest of its class yet built in Canada.

The shipments of coal from the Dominion Coal Co.'s mines at Sydney, for September, were 183,000 tons. The Nova Scotia Steel Co., now owners of the General Mining Association's "Old Sydney Mines," intend to increase the output from its present rate of 300,000 tons a year to 750,000 tons or more. A railway and wharf will be built to enable two large steamers to load at a time, at Point Aconi. The coking ovens at Sydney mines are now in course of construction.

S. J. Ritchie, now of Toronto, has brought suit against Judge Burke and his wife, and against C. W. Bingham, all of Ohio, to recover the value of certain shares in the Canadian Copper Co., the Anglo-American Iron Co., and the Central Ontario Railway. These suits have been pending for some time, and the claims aggregate $2,000,000. Very peculiar transactions are alleged against Judge Burke in connection with the Canada Copper Co., the United States concern which has heretofore controlled the nickel output of Canada.

The unqualified success of the excursion of the American Institute of Mining Engineers to the Pacific Coast in 1899 prompted it, upon the cordial invitation of its Canadian members and friends to hold its summer meeting this year in Canada in connection with an extensive trip to the principal mining and metallurgical centres of Nova Scotia and Newfoundland. The excursion lasted two weeks. During that time the members visited the mining and machinery manufacturers, at Sherbrooke, Que., including the Jenckes Machine Co. and Canadian Rand Drill Co., the asbestos mines of Thetford and the city of Quebec. In Nova Scotia the principal points of interest were the coal mines and new steel plant, which are being opened up by Henry M. Whitney, of Boston, Mass. At Sydney, the Nova Scotia Steel Co.'s works and the Intercolonial Coal Co.'s mines at New Glasgow, and the Waverley gold mines at Halifax. Some of the party also visited the iron mines of Newfoundland, and the Nova Scotia journey was enlivened by trips to Louisburg, Pictou, Bras d'Or Lakes, Halifax and other points of interest.

Marine News.

A steamboat is to be built this fall at Sand Point, for the use of the Upper Ottawa Forwarding Co.

The Montreal Transportation Co. will build at once a large barge, and also a river tug. The specifications are now about completed.

The Shipbuilding, Drydock and Wrecking Co., of Collingwood, Ont., has changed its name to the Collingwood Shipbuilding Co., Ltd.

The Lake Ontario and Bay of Quinte Navigation Co. will build another steamer this winter, their present accommodation not being sufficient.

The canal boat "Stetson," which foundered in Lake Ontario during a heavy storm, has been purchased by Capt. Ira B. Folger and taken to Kingston, Ont.

R. Davis, Kingston, Ont., is preparing plans for a 45 foot steam yacht, to be built at that place this winter for a Buffalo man. The yacht will cost $3,000.

Col. Wm. P. Anderson, well known to vessel men as chief engineer of the Canadian Department of Marine and Fisheries, has been carrying off great honors at rifle shooting lately. He recently won the Governor General's prize of $200, and a gold medal, which makes him the champion rifle shot of Canada for this year.

It is said that a fleet of five vessels with a capacity of 15,000 tons, will be engaged next year to operate in connection with the Great Northern Railway.

The Donnelly Wrecking & Salvage Co., Kingston, Ont., have succeeded in raising the schooner "Volunteer," which sunk sometime ago at Belleville, Ont.

The steamer "Strathcona," of the Hamilton and Fort William line, is in drydock at Buffalo, having several of her plates repaired. This boat scraped bottom in going through the St. Lawrence, injuring her hull.

It is said that the Canadian Northern will have two steel passenger boats built this winter to ply between Port Arthur and the lower lake ports. They are to be equipped with the most modern machinery and have a speed of 18 to 20 miles an hour.

The Conners' Syndicate, who have made a start on the grain elevators at Montreal, propose to build a number of barges and steamers for their carrying trade on the lakes. The Swan & Hunter Shipbuilding Co., Wallsend-on-Tyne, may get the contract.

The Elder-Dempster Co. has given out contracts for the construction of two large cargo steamships to be placed on the Canadian route. One will be built by the Armstrong-Mitchell Co., and the other by Swan & Hunter. Both will be of 12,000 tons and will have a speed of 13 knots.

The tugs "Thistle," of Kingston, and "Dey," of Cardinal, are in Davis' drydock, Kingston, for repairs. The former is owned by the Lake Ontario Fish Co., and will be placed in commission by that company, which has previously been using sail boats for their business.

The new steamer built at Rat Portage, Ont., for the Rainy River Navigation Co., will be launched in a few days. It has been built for passenger as well as freight service, being fitted up with twenty-two state rooms, and will be the first flat bottomed steamer to ply on Rainy River for some years.

The steamer "St. Andrew" was wrecked last month on Blanchard Island, near Black Bay, 40 miles from Port Arthur, owing to the deflection of the steamer's compass from lying near beds of magnetic iron. The "St. Andrew" was owned by Playfair & Co., of Midland, Ont., and Capt. Featherstonhaugh, of Hamilton, Ont., the latter being in command.

The portion of the Trent Canal lying between Balsam Lake and Lake Simcoe, has been divided into three sections for the purpose of construction. Section No. 1, extending to Kirkfield, has been practically completed by the contractor, A. Onderdonk. The contract for the middle section, No. 2, has been let to Larkin & Sangster, St. Catharines, and section 3, which carries the canal into Lake Simcoe, at Gamebridge, has been let to Brown & Aylmer, Toronto. The work will be completed within two years.

Personal.

R. P. Fisher, representing the Thorncliffe iron works, Sheffield, England, has been visiting Canada.

Alex. Marr, second engineer of the steamer "Strathcona," was drowned at Fort William, Ont., Sept. 21st.

J. W. Marr, late chief engineer of the Metropolitan Ry. Co., has been appointed to take charge of the electric plant of The Toronto Evening Telegram.

W. A. Winfield has been appointed Eastern Superintendent of the Nova Scotia Telephone Co., with headquarters at New Glasgow.

F. P. Featherstonhaugh, B.Sc., McGill, Montreal, has gone to Ottawa, where he will be resident partner of Featherstonhaugh & Co., solicitors of patents.

V. E. Payne, formerly with the Royal Electric Co., and latterly with the Packard [illegible] Co., is now with J. Forman, electrical machinery agents, Tyrrell [illegible].

H. C. What[illegible] and New York valve manufac[illegible] at last has its own literary [illegible] Ontario and Quebec ha[illegible]er issued in July will compare in q[illegible] any magazine published across the [illegible]

F. J. Robinson, C.E., is now in charge of section No. 2 of the Trent Valley Canal, having been appointed assistant to the chief engineer.

P. McCullough, son-in-law of And. Sangster of the Sherbrooke Gas and Water Co., has been appointed assistant manager of tramways at Liverpool, England, at a salary of £500 per year.

W. E. McCubbin, of Peterboro, Ont., who travelled for the Metallic Roofing Co., Toronto, was found dead in bed at Campbellford, N.B., Sept. 20th. Heart disease was said to be the cause of death.

The Central Railway bridge at Sargeson, N.B., gave way under a freight train last month, and the engineer, J. Duncan, was instantly killed, and W. Bernard and F. Campbell, brakemen, were seriously injured.

Ralph D. Marchand, for some years expert for the Westinghouse Co. in long distance transmission, has been appointed to a similar position with the Montreal Street Ry. and the Chambly Manufacturing Co.

F. B. Nicholson, representative of the Kingstone Mnfg. Co., Buffalo, makers of the famous nonpareil wrenches and ratchet drills, Westcott adjustable wrenches, called on us last month. Mr. Nicholson is well-known to the Canadian buyers of these goods.

W. B. Anderson, assistant engineer for the Lake Superior Power Co., at Sault Ste. Marie, has been appointed mathematical lecturer at the Royal Military College, Kingston. He is a son of Col. Anderson, engineer of the Department of Marine, Ottawa.

After a connection of exactly six years, S. J. Robertson has left the staff of The Canadian Engineer to take charge of the new University of Toronto Monthly. Mr. Robertson is a brilliant young journalist with a true literary instinct, and is making his mark in the profession. He bears with him the very best wishes of his confreres.

John O'Donohue, of Ottawa, who was pursuing a course in electrical engineering at the General Electric Works at Schnectady, N.Y., was instantly killed on the 2nd inst. He was in the dynamo testing department and during an hour's wait between tests he lay down on a 24-inch belt, and fell asleep. The power was turned on and his body was rapidly carried to the fly-wheel, where it was badly crushed.

The dismissal of John Galt, city engineer of Ottawa, on the request of the Board of Works of that city, has been a sensation of the capital this month. Mr. Galt complains that the delays and difficulties of his department were caused by the penurious policy of the council, which prevented him from employing proper help. Newton J. Ker, his assistant, is spoken of as his successor.

Rev. John McLeod, pastor of the Presbyterian church at Vankleek Hill, Ont.; H. Golden, stonemason, and Auguste DeLorme, laborer, were killed by the falling of the gable wall of the church, which was under construction. The coroner's jury attributed the deaths to bad material and workmanship.

The Chicago Pneumatic Tool Co., Chicago, has F. F. Bennett as sales agent and manager of advertising, with headquarters at the main office of the company, Monadnock Building, Chicago. Mr. Bennett was formerly sales agent for the American Steel Casting Co., and the American Coupler Co., of Chester, Pa.

C. J. F. Baby, who was chief accountant of the Cataract Power Company, and now is assistant manager of the Packard Electric Co., St. Catharines, Ont., was presented before leaving Hamilton with a solid silver tea service as a token of the esteem in which he is held by the Cataract Power Company and his fellow-employees. Gordon Henderson read an address and made the presentation.

Wallace P. Cohoe, M.A., has been appointed lecturer for one year in chemistry and geology in McMaster University, Toronto, to succeed Prof. Wilmot. He was a graduate in Arts of McMaster Uni[illegible] William C. Macdo[illegible]k his M.A. there in 1868. He then [illegible] to the cause of education [illegible] was made chief assistant in the [illegible] which Sir William Macdonald he[illegible] her honors received.

In the Rathbun Co.'s mill at Gravenhurst, Ont., last month Chas. Clarke, who had been in the employment of the company for fifteen years, was scalded to death by the breaking of the steam main leading from the boilers to the engine whose governor he was repairing. The jury found that death was "caused by a defect in an expansion joint in a steam pipe, that there should have been a shut-off valve between the expansion joint and the boiler, and that the engineer failed of doing his duty on that occasion."

T. W. Atterbury, M.E., late of the Goldie & McCulloch Co., Galt, and the Polson Iron Works, Toronto, at one time connected with the locomotive and car departments of the C.P.R., and for a number of years chief draughtsman of the Laurie Engine Co., Montreal, has opened an office as consulting mechanical engineer in the Canada Life Building, Toronto. Mr. Atterbury is well known to Montreal engineers as a successful designer of large steam engines and direct-connected units.

E. J. Philip, well known to many of our readers as a clever young mechanical and electrical engineer, and for several years in charge of the steam and electrical plant of the T. Eaton Co., has started in business for himself as consulting engineer, and head of the Steam Specialty Co., of Toronto. He has already been offered the agency of some of the best American specialties, and will no doubt have all the business he can attend to. Mr. Philip is an able writer on mechanical subjects—an article from his pen appearing in the present issue, and many others having appeared in previous numbers of The Canadian Engineer—and has done much to promote the educational interests of the Canadian Association of Stationary Engineers.

T. O. Bolger, city engineer, Kingston, Ont., died last month at the age of 60. He had held the position since 1887. After studying as a boy in the office of the late F. J. Fitzgerald, surveyor, Peterboro, he acted as surveyor for the Page Lumbering Co. for several years, and in 1874 formed a partnership at Belleville with John D. Evans, now chief engineer of the Central Ontario Ry. He prepared maps of both Belleville and Trenton. After making township surveys in Manitoba for the Dominion Government he assisted in locating the C. O. Ry., and was in charge of constructing the northern division in 1882-4. While in Kingston he designed a new waterworks system, and made a detailed report of the sewerage

KINGSTON SCHOOL OF MINING.

The following new appointments on the staff of the School of Mining, Kingston, Ont., have been made: L. W. Gill, B.A.Sc., has been appointed to the new chair of Electrical and Mechanical Engineering. Professor Gill is a distinguished graduate of McGill University. After graduation he studied for two years as exhibition research scholar, and had the distinguished honor of being offered the scholarship for a third year. This scholarship is of the annual value of £150 sterling, and is awarded by Her Majesty's Commissioners from funds remaining from the receipts of the Exhibition of 1851. Mr. Gill's work as research scholar was carried on partly at McGill, and partly at Harvard University. Since the completion of this work he has been in the employment of the Westinghouse Company, Pittsburg. John Waddell, B.A., D.Sc., Ph.D., has been appointed lecturer on Industrial Chemistry. Dr. Waddell's education is unusually broad and thorough. He graduated in arts from Dalhousie University, then in science from the universities of London and Edinburgh, and later won the degree of Doctor of Philosophy in the University of Heidelberg, where he studied under the great Bunsen. He has made substantial contributions to research in chemistry, and is the author of a textbook on the Arithmetic of Chemistry, which has been pronounced by a reviewer in the Journal of the American Chemical Society, the best he has yet examined. Demonstrators have been appointed in Mineralogy and Geology, A. G. Burrows, M.A., in mineralogy, and M. B. Baker, B.A., in geology, both graduates of Queen's University. The mining laboratory has been rebuilt so as to give twice the space for machinery, and a lecture room and testing laboratory. The Carruthers Science Hall has been improved by the addi

tion of a ventilating system controlled by fans for removing the foul air and replacing it with pure warm air.

A new lectureship in Applied Mathematics, open last spring, has been lately filled by the appointment of C. R. McInnes, who graduated from Queen's University in 1896 with first-class honors in mathematics, taking the degree of Master of Arts. He continued his studies as a post graduate student in Johns Hopkins University. During his three years there he distinguished himself as a mathematician, and was awarded several scholarships and appointed to a fellowship. He also assisted the Professor of Mathematics, Dr. Craig, in certain parts of the work. In June last he graduated from Johns Hopkins, attaining the degree of Doctor of Philosophy. His appointment will strengthen the staff of the School of Mining at a most important point.

FIRES OF THE MONTH.

Sept. 18th. Whitelaw's foundry, Woodstock, Ont.; loss, $30,000 to $40,000.——Sept. 20th. Standard Chemical Co., Descronto, Ont.; loss not given.——Sept. 22nd. P. & P. Griffin, Toronto, curled hair factory; loss, $25,000. W. Harris & Co., Toronto, glue and hair factory; loss about $20,000.——Sept. 26th. Brown & Scrimger, Galt, trunk factory; loss about $2,000. Canadian Portland Cement Co., Marlbank, Ont.; loss, $60,000. ——Oct. 4th. House of Providence, Dundas, Ont.; loss, $30,000; insurance, $10,000.

ACCIDENTS OF THE MONTH.

A collision occurred on Sept. 15th between two freight trains on the Esquimault and Nanaimo Railway, killing Sam Walton, engineer, Toronto; Robt. Fisher, superintendent Crow's Nest Pass Coal Co.; Hugh Thomson, fireman, and Henry Saunders, brakesman.——James Turner, a carpenter at Easson's planing mill at Stratford, Ont., met with what may prove a fatal accident while putting a belt on a pulley.——William Burd, Midland, Ont., was caught in the shafting at Playfair's mill on Oct. 1st, and instantly killed.——Albert Westfall, employed in the War Eagle mine at Rossland, B.C., was killed by a descending skip on Sept. 24th.——Owing to the bursting of a valve in the Chatham, N.B., pulp mill on Sept. 26th, one of the employees was badly scalded.——Harry Jamieson, of Centralia, Ont., met with an untimely death while repairing the boiler at D. S. Perrin & Co.'s factory at London, Ont., on Sept. 28th. ——E. C. Carter, engineer at the waterworks at Niagara Falls, Ont., met his death Sept. 10th by being carried down the flume at the pump-house. He was a brother of Capt. Carter of the "Maid-of-the-Mist."

THE USE OF THE DYNAMO AND STORAGE BATTERY IN TELEGRAPH OFFICES.*

BY W. J. CAMP, SUPERINTENDENT C.P.R. TELEGRAPHS.

Previous to 1870, acid batteries of various kinds were used for main telegraph circuits, and the Daniel form of blue-stone battery for the locals, or sounding circuits. Between 1870 and 1874, what is known as the "gravity battery" was brought into general use. This is a modification of the Daniel cell, but the sulphate of zinc and sulphate of copper solutions are kept separate by the difference in their specific gravity instead of by means of a porous cup. This form of battery is very constant and requires but little attention as compared with the acid. To obtain the best results not more than two or three wires should be worked from each bank. While the change from acid to gravity batteries effected a great economy in maintenance, and improvement in the working of the telegraph wires, a much greater stride has been made by the introduction of the dynamo and storage battery in telegraphic work.

About 1880 dynamos were introduced by the Western Union Telegraph Co. at New York for supplying current to the single working wires. For doing this two dynamos are used, each of a voltage high enough for the longest wires; the positive pole of one and the negative pole of the other dynamo are earthed, and the opposite poles connected to two buss wires. The various single working wires are connected to these buss wires, according to the polarity required, through an artificial resistance for each wire. The Western Union in the United States, and both companies in Canada use incandescent electric lamps for these resistances. The Postal Co. in the United States uses German silver wire wound on tin tubes, so designed that, should any heating take place, it is counteracted by a current of cold air which passes through the tube. Additional resistances were inserted on the shorter wires to make all lines approximately of the same electrical length. These resistances were usually of fine German silver wire wound on the handle of a wedge which was inserted with the instrument wedge in the spring-jack of the switch. It has been found much more satisfactory, however, to have several dynamos giving different voltages, and the use of the resistance wedges abandoned. The next step was to apply dynamo power to duplex wires. When using the gravity battery the transmitter (pole changer) was arranged to reverse the poles of a bank of battery from earth to line and vice versa. This pole-changer required very accurate adjustment in order to reduce the time of reversals to a minimum; the least break in the circuit, or short-circuiting of the battery, being liable to affect the signals at either or both terminals of the line. For dynamo power the earth connection is omitted in the pole-changer; the armature is connected to the line circuit, the front contact to the negative buss wire, the back contact to the positive, and resistances of 600 or more ohms inserted ahead of each buss wire to prevent arcing at the contacts of the pole-changer. Then came the application of the system to quadruplex circuits. Great difficulties had to be overcome to effect this. Two entirely different systems are in general use, one by the Western Union and Great North Western Telegraph companies, and the other by the Postal Telegraph Co. The Canadian Pacific Co. uses the W. U. system at Toronto and Montreal and the Postal system at other points.

Duplex is a system by which two operators can transmit simultaneously in opposite directions. This is attained by winding the receiving relays with two coils of wire in opposite directions, one winding being connected to the line, and the other to a set of resistance coils and condensers which are so adjusted that the electrical length and static capacity are the same as the real line. The home power divides equally, half passing around the core in one direction to the real line, and half in the opposite direction to the artificial line; the result being that the core is not magnetized by it, and is not susceptible to any change in the home power. As the power coming over the line from the distant station only passes through one of the coils, and there is none coming in from the artificial line to counteract it, the core is affected by any change in power at the distant station. The receiver is a polarized relay whose armature closes the sounder when moved in one direction, and opens it when moved in the other. The transmitter is an instrument worked by an ordinary telegraph key and local circuit. It is so arranged that, when the key is depressed the negative pole is connected to the line, and positive when the key is opened. Quadruplex is a system by which two operators can transmit one way simultaneously with two operators transmitting in the opposite direction, i.e., four messages can be sent simultaneously on one wire, two in each direction. The arrangement by which two operators transmit in the same direction may be briefly described thus: A transmits by reversing the polarity to line the same as in duplex, and C receives by means of a polarized relay. B transmits by increasing and decreasing the same power which A is reversing; D receives from him by means of a neutral relay which responds to power of any direction if it is strong enough. The retractile spring of the armature is adjusted so that the weaker power does not move the armature, but when the full power is on the spring is overcome. By double winding both receivers at each end as explained for the duplex, we obtain "two circuits in the opposite direction."

We now come to the locals. For ordinary sounder circuits a very simple plan is to [illegible] of 6 volts and connect all sounders in multiple [illegible] circuits, Tyrrell [illegible] wound to 20 ohms resistance but [illegible] dynamos are used there are al[illegible]d at last has its own literary [illegible]'s often necessary to co[illegible]er issued in July will compare in q[illegible]ber of sys-[illegible]ny magazine published across the C[illegible]

*Extracted from a paper read before the Canadian Electrical Association

tems, but I will only describe the one in use by the C.P.R. This is, I think, the most simple yet designed.

Sometimes the dynamos are operated from a common shaft driven by an electric motor or other power, but the plan most generally adopted is to use motor generators, each machine working independently. In order to be reasonably certain of a continuous supply of power, spare leads are run to different power stations, and spare machines are also kept in readiness, so that not more than a minute or so is lost at any time. In cities where continuous power cannot be obtained from at least two different stations, storage batteries are now largely used. Generally speaking, the wiring of a telegraph office, from the discharge leads of a storage battery to the instruments, etc., is the same as for dynamos, but extra switches have to be used for connecting the various banks of battery with the charging or discharging circuits. Various devices are used, but as I consider the C.P.R. system the most flexible, I will describe it only. At Vancouver the Winnipeg street railway power is transformed by two motor generators; one reducing the power to seven volts of twenty amperes capacity for charging local batteries; and the other to 130 volts, 5 amperes, for main batteries. In Ottawa a 250-volt power is reduced to seven volts for the locals and the mains are charged direct without reduction. In St. John the 114 volt lighting circuit is used. The locals are in two banks of two cells each, of chloride accumulator, type E. 9, one bank being charged while the other is discharging. There is no dead resistance inserted in the local circuits as is the case where dynamos are used, extra cells providing the necessary power when quadruplexes or duplexes are extended to branch offices. The switch for the main batteries consists of a series of springjacks and wedges, so designed that the jack is open, and a wedge cannot be inserted when reversed. The cells (which are C3 type of accumulator) are arranged in banks of 40 or more as needed to meet the requirements of the office, and of a voltage sufficiently below the charging circuit. The negative pole is connected to the top of a wedge, and positive to bottom. The wedges are all interchangeable. As many banks as required can be charged simultaneously. In Canada, the C.P.R. has storage battery plants at Vancouver, Winnipeg, Ottawa and St. John, and dynamos at Toronto. The new Telegraph building in Montreal will also be equipped with dynamos. At present power in the latter place is obtained from the dynamo plant of the G.N.W. Tel. Co. I understand that the W.U. and G.N.W. companies have storage plants at St. John, Quebec, London and Ottawa, and dynamos at Toronto and Montreal. The adoption of either dynamos or storage battery for power on telegraph lines has very materially improved the working of the lines, and at the same time effects a great economy. One or the other will gradually replace gravity batteries for all main lines, and the time may come when even the locals at wayside stations will be worked by storage battery cells which will be charged at some central point and sent out by train.

THE ENGINEER, THE MASTER SPIRIT OF THE AGE.

BY C. BAILLAIRGE, C.E., F.R.S.C., ETC.

(Concluded from July issue).

In 1889 London was to have built an "Eiffel" limited to a minimum height of 1,200 feet. Sixty eight designs were submitted hailing from all quarters of the civilized world. A design by the writer for a tower 1,600 feet in height, 280 feet in diameter, weighing 14,000 tons, and to cost more than a million of dollars, was fifth on the list in the illustrated volume, published by the company, though in truth it should have been the first, as the only one embodying, if not as artistic in design as others, the solution of the specified condition that the tower in case it was not a financial success, should be capable of being decomposed into separate stories to be sold to surrounding towns and cities for re-erection as pavilions for exhibition and other purposes.

Foundations in William C. Macdonald laid in a variety of ways. Among to the cause of education are those where the pneumati which Sir William Macdonald ha here the pressure of the n the sinking of ir l in with concrete or masonry, and built upon; but when deeper water is at hand, as at Hawkesbury in Australia, men cannot work under the pressure of six or more atmospheres, and other methods have to be devised. At Hawkesbury the depth was close upon 200 feet, but there was the advantage of 80 feet of silt to fix and retain the piles and tubes driven down. It is so with the proposed bridge over the St. Lawrence at Quebec, where, there being nothing to confine the legs of the structure in 160 feet of water, and no engineer at hand to solve the problem, it was determined, on the plea of economy, to erect the bridge at Cape Rouge, some seven miles above the city, where the stretch is narrower, and the piers projected to be in only 40 feet of water. The writer had solved this problem more than forty years ago, and for proof, his plans of the solution may still be seen in the city engineer's rooms and corridors at the city hall, Quebec, where for a bridge opposite the city the stretch is 4,800 feet from cliff to cliff, the proposed structure having three 1,200 feet spans and two 600-ft. half spans to be founded, the shore piers in 40 ft. of water, the mid-stream ones at a depth of 160-ft., by first building and sinking auxiliary cribs to surround the piers proper, and thus render their construction feasible. These would be built with twin wells or pits of proper size in which to sink iron caissons braced against outside pressure and thereafter filled in with concrete or masonry from which to start the piers.

The bridge at Cape Rouge would of course cost some two to three millions less than opposite the city, but as the writer surmises, the interest on the additional cost at Quebec would be largely, if not entirely made up by revenue from local traffic across the bridge, electric trolley lines, vehicles, foot passengers, none of which would obtain at Cape Rouge, and by berths for ocean and other steamers and river craft lying alongside the outer or auxiliary cribwork, surrounding the piers proper to a minimum width of some 60-ft on all sides, and thus capable of being used for commercial purposes, while at the same time the bridge piers above high tide line, and for 150 feet in height or up to level of apron of superstructure, might, by being built of skeleton iron and steel construction, and enclosed by outer riveted sheeting, be utilized as grain elevators or for other purposes of storage, etc.

An article in a recent issue of the New York engineering paper alludes to wire cables or suspension bridges as of American conception. The article goes on to say that to America is also due the idea of the composite bridge or of that where the cable is used to support the weight of structure, while with it is combined the trussed or trellised bridge or tube to stiffen it, and prevent all oscillation, which otherwise would occur on the passage of heavy traffic. On this head I may say, and as proof of how men's minds may run in the same groove, or how one man may reconceive or reinvent what has existed long before his time, that at the city engineer's office, Quebec, may be seen, attached to the rear wall of the Recorder's Court, a plan some 30 feet in length of the then proposed bridge over the St. Lawrence at Quebec, and in his drawers are enlarged plans and sections showing that already at this early date (more than forty years ago, or while Stevenson was building the Menai and the Victoria), Mr. Baillairge had foreseen the necessity of the combined system as since carried out.

The writer's supposed stiffening tube was to have been some 40 feet in height or depth with tram and ordinary foot and vehicle traffic over the upper deck of tube or at the 180-ft. level and over of Dufferin Terrace, while the proposed steam traffic took place on the deck below at 150 ft above the St Lawrence, or at the level of our Frontenac Park.

It would be hopeless, Mr. Editor, within the scope of an article like the present to go over the whole field of engineering achievements; but to summarize; the engineer has made travel cheap and easy both by sea and land. His electric cables span all seas but the Pacific, which they now shortly are about to do, and telegraph, telephone, trolley and other wires cover the land in every direction. He has given power to the world by harnessing Niagara. The engineer has watered the world and rendered fertile barren wastes of vast extent.

At the recent convention of civil engineers one of the Boston contingent stated that Massachussets is now devising a system of water supply not only for Boston proper, but for some 28 towns and cities surrounding it and within a radius of

50 miles, and has dammed in an area of not less than 6[illegible] square miles, and made reservoir to contain billions of gallons.

The engineer has scavenged the world, and has gas and electric lighted it, and is now about to heat it by the same process. He has diminished the cost of living by his labor-saving appliances as at Boston, again, where they can produce gas at 30 cents a 1,000 feet. He has economized space, as Francis has done at the Back Bay Station, Boston (the largest in the world to date), by building beneath it a sub-station for freight and merchandise. He has relieved crowded thoroughfares, as at New York, by his elevated railways, or by going down into the bowels of the earth.

In the post-prandial speeches at our annual dinner at Boston, Presidents Allen and Bovey, of the Boston and Canadian contingents, dwelt upon this theme of the achievements of the engineer, though in other respects than those touched upon here, and so did Mr. Fitzgerald, past-president of the American Society of Civil Engineers, and it will be remembered how happily Mr. Bovey sketched out much that the engineer has done for man's commodious travel by land and sea, at our annual dinner last year at the Windsor, Montreal.

There is, however, another and a more summary way of judging of the merits and qualifications of an engineer in comparison to those of persons exercising other callings. It is this: Of an engineer or other man of common sense you can make a boss, an alderman, a mayor, a premier, a president, a king, or a czar, a commander, and even a Kruger, but of none of these can you make an engineer without years of study, practice and the keenest of observation.

—The James Packingham Packing Co., of Stouffville, Ont., have placed an order with Wm. R. Perrin & Co., Toronto, for all the machinery for their new pork packing establishment, which will be built this fall.

—Leopold and Charles Meyer and Geo. S. Lawlor, of Boston, visited Kingston this month, and assured members of the city council that machinery for the projected smelting plant is now being made in Philadelphia, and plans for the works are now in preparation.

—The annual banquet of Toronto C.A.S.E. No. 1 will be held on Wednesday evening, October 17th, at the Walker House; tickets, $1. The committee is composed of J. W. Marr, W. L. Outhwaite, W. J. Webb, H. E. Terry, S. Thompson, John Fox, James Bannon, A. Storer, A. M. Wickens, G. C. Mooring.

—In the annual report of the Dominion Government's department of printing and stationery, attention is drawn to the fact that modern books and documents are much more perishable than those of olden times. The books which Columbus read may now be read as easily as when they were first printed, and the notes he made on their margins are as legible as when he wrote them. The entries in the customs house records of the reward paid for discovering America are still black, but, upon the receipt for the amount paid in the Alabama award some of the endorsements have already turned brown and are fading away. The perishable character of recently printed books is due mainly to two causes—the use of wood pulp not thoroughly prepared, and the introduction of heavily clayed glossy papers necessary for printing photographic process blocks of low relief. This matter is one of the highest importance, so much depending upon the permanence of legal and other records.

Mechanical Engineer

For head of draughting office in a factory, building stationary and marine engines, boilers, saw-mill, pulp and general machinery; four hundred employees. A graduate of technical school with at least ten years' experience. This is a good opening for a bright, thoroughly up-to-date man. Address M.E., care of Canadian Engineer, Toronto. 10-3

SCIENTIFIC TEMPERING.

Important to Machinists and Manufacturers—The method of hardening employed by The Dominion Button Works, Montreal, has proved remarkably superior to every other system. A department for outside work was opened last spring. Already some of the most important manufacturers in the city get their hardening done by the new process. Milling Cutters, Reamers, Dies and Punches, Taps, Jewellers' Tools, Case Hardening, **and anything that needs temper,** 100 per cent. more wear guaranteed. Every piece warranted. Correspondence solicited. References given. Agent will call if required.

DOMINION BUTTON WORKS, 428 Visitation St., MONTREAL.

We Excel and Undersell All.

OHIO ELECTRIC WORKS
POCKET FLASH LIGHT.
$1.50
ELECTRIC CARRIAGE LIGHT.
$5.00
BATTERY TABLE LAMP
$3 COMPLETE
$5.95
TELEPHONE COMPLETE
WE ARE SELLING
Battery Hanging Lamps $10.00
Telephone, complete, - 5.95
Electric Door Bells, - - 1.00
Electric Carriage Lights, 5.00
Battery Fan Motor, - - 5.95
Electric Hand Lanterns, 2.00
Pocket Flash Lights, - 1.50
Miniature Electric Lamps, .40
$8 Medical Batteries, - 3.95
Genuine Electric Belts, 1.00
$12 Belt with Suspensory, 2.50
Genuine Electric Insoles, .25
Telegraph Outfits, - - 2.75
Battery Motors from $1 to 12.00
Battery Table Lamps, - 3.00
Necktie Lights, 75 cts. to 3.00
Bicycle Electric Lights, 2.25
Electric Cap Lights, - 2.00
Electric Railway, - - 3.50
Battery Student Lamp, - 4.00
Dry Batteries, per dozen, 2.25
Electric Books at low prices.
We undersell all on Everything Electrical.
OHIO ELECTRIC WORKS
CLEVELAND, O.
Headquarters for Electric Novelties and Supplies.
Agents wanted. Send for New Catalogue, just out.

Ask for Discount Sheet.

CARBORUNDUM

THE IDEAL ABRASIVE

The Canadian Factory of the Carborundum Company is now fully established, and the Canadian Trade can be promptly furnished with Crude and Graded Carborundum for all grinding and polishing purposes, and with Carbide of Silicon for Steel making. By special arrangement, Genuine Carborundum Wheels and Specialties can be obtained from the Hart Emery Wheel Co., of Hamilton, Ont.

[illegible] agents, Tyrrell [illegible]

THE CARBORUNDUM CO., - NIAG[illegible]

[illegible] at last has its own literary [illegible] issued in July will compare in qu[illegible] any magazine published across the [illegible]

The Canadian Engineer

VOL. VIII.—No. 7. TORONTO AND MONTREAL, NOVEMBER, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

SEE PAGE 138 FOR CONTENTS.

MANUAL TRAINING IN CANADA.

BY W. W. KING, M.A., QUEBEC.

It is so essential that the public of Canada should receive some data upon this work, now being introduced into the country, and manual training is so intimately connected with technical work, though quite distinct from it, that some information in regard to the new-born Canadian sloyd will, no doubt, be welcome to readers of this journal.

Slojd (English, sloyd), is a Swedish term for dexterity, connected with the English word sleight, in the phrase "sleight-of-hand." This system of manual training may be said to have taken its rise in Sweden, under the late Herr Abrahamson, and his nephew, Herr Salomon. The former, who owned an estate at Naas, in Sweden, opened a work-school for the children in 1872, appointing his nephew to the position of director. From this beginning the work has grown, and now Herr Salomon holds the post of director of the seminarium for teachers at Naas. Since 1882, the training at this now famous school has been given in short courses of six weeks, open to teachers only, from Sweden or from abroad, preference being given to applicants who can show that they have an immediate prospect of teaching the work. It is calculated that Herr Salomon has now sent out between three and four thousand trained sloyd teachers to all parts of the world. These have been gradually introducing the work into the various countries of the continent of Europe, into Great Britain and Ireland, and into the United States of America; and now begins its introduction into our own country.

The sloyd system of manual training is being introduced into Canada by Professor Robertson, through the liberality of Sir William C. Macdonald, of Montreal, whose gifts to the cause of education are well known. The fund which Sir William Macdonald has established is intended to equip and carry on for three years a sloyd school in one place in each province of the Dominion, and also as many schools in Ottawa as may be deemed necessary to give the training to all school boys of a suitable age. During this winter there will, accordingly, be schools of sloyd in Ottawa and Brockville, Ont.; Sherbrooke, Knowlton, and Waterloo, Que.; Charlottetown and Summerside, P.E.I.; Truro, N.S., Fredericton, N.B.; Winnipeg, Man.; Calgary, N.W.T.; and probably Vancouver, B.C. The directors of these schools will be trained men brought from England and elsewhere; and it is expected that they will gradually train Canadian teachers to carry on the work as their assistants. Hence a start has been made by holding in July-August, a teachers' training course at Brockville, and another at Fredericton, in which some twenty-five teachers in all have begun their sloyd work.

The system itself must now be described. And in the first place it is needful that the reader should cease to have an idea that sloyd woodwork is, in any sense, carpentry, or intended as an introduction to that trade. Sloyd is a means of education and valuable solely for its formative influence on the child's character. Carpentry is a trade and has its utilitarian value as such. The only connection between sloyd and carpentry is that they both make use of wood as a material and use the same tools.

Having thus cleared the view, we may go on to see just what sloyd is and at what it aims. The aims of sloyd as regards the formation of character in the child, are: 1. To instil a taste for, and a love of, labor in general; 2. To inspire respect for rough, honest bodily labor; 3. To develop independence and self-reliance; 4. To train in habits of order, exactness, cleanliness, and neatness; 5. To train the eye and sense of form; to give a general dexterity of hand, and to develop touch; 6. To accustom to attention, industry, perseverance and patience; 7. To promote the development of the physical powers. Now it is obvious that each and all of the above aims of sloyd should be of prime importance in any rational scheme of education; and we find from the evidence of hundreds of educators that sloyd, or educational handwork does cultivate the virtues enumerated above.

Furthermore, sloyd is handwork in wood. Why not in other materials? When this means of education was introduced into Swedish schools, various other materials were used, but finally all others were discarded in favor of wood, because it was the only material which satisfied the following ten requirements: 1. The material used should accord with the children's capability. 2. The work must excite and sustain interest. 3. The objects made should be useful. 4. The training should give respect for rough work. 5. And train in order and exactness. 6. The material used must allow of cleanliness and neatness. 7. The work must cultivate the sense

of form. 8. And be beneficial from a hygienic point of view. 9. The course should allow of methodical arrangement. 10. The work must teach dexterity of hand.

It is true that some other branches of the original sloyd fulfil several of these requirements, e.g., simple metal work, straw-plaiting, cardboard work, wood-carving, etc.; but wood is the only material which satisfies every requirement of the ten. When it is also taken into consideration that each kind of material used in sloyd forms, in reality, a new school subject; and that it is a waste of energy for both teachers and scholars to have more school subjects than are absolutely necessary, it will readily be seen that the interests of education are best served by choosing one satisfactory material for sloyd and using it throughout. It should be observed, however, that sloyd woodwork is intended for children from eleven or twelve years of age upwards. In the full course, which will probably be established ultimately in our schools, the children will, on leaving the kindergarten, at seven years of age, be given training in advanced paper-folding for two years, and in elementary cardboard work for the next two years; and will then enter on woodwork when thus trained to thoroughly profit by it.

Now, as to what it is actually proposed to do at present in Canada. Take, for example, Ottawa, which will be the centre of the movement, during its initial stages, at least. During next winter, there will be in that city two "centres," or sloyd rooms, where instruction will be given to the teachers in the Ottawa Normal School, and to all the boys of suitable age in the Ottawa Public Schools. The work will be in charge of Mr. A. H. Leake, of Leicester, England, an experienced sloyder and a graduate of Naas. He will have immediate control of the chief centre, with two or three assistants, some of them Canadian teachers, and will supervise the work in the other centre, where another trained man will have charge, with an assistant. To these centres the Normal School students and the school boys will come in drafts, the former receiving practical training and lectures on the theory of sloyd, and the latter chiefly practical work. The boys will receive two or three hours per week instruction, and the full course for them is one of about three years.

The work is carried on by means of a system of "models," or objects, which each boy makes entirely for himself, there being thirty such models in the three years' course. The course begins with simple objects, such as a wedge, a round flower stick, a square ruler; goes through a more difficult series, such as a paper knife, a picture frame, a scoop; and concludes with book shelves and a cabinet, involving difficult operations such as dove tailing, etc. The course is so arranged that each model represents some slight advance upon the one that preceded it in the course, either some new tool, or some new use of a tool, previously employed, being introduced in the making of it. The utmost importance is attached to having each object, when made, the work of one individual pupil. There is no division of labor, and the teacher himself must give to the pupil not the slightest assistance upon the actual model. When he wishes to show the pupil how the work should be done, the demonstration must be made upon another piece of wood. It is also an essential to the system that the utmost accuracy be insisted upon. The metric system of measurement is employed, and even a finished model is rejected for the slightest deviation from the measurements laid down in the drawing. A model, if rejected, must be again begun by the pupil, and brought to a successful conclusion before any advanced work is done; though it is sometimes found advantageous to allow the pupil to proceed temporarily with the next, after one or two failures, since he comes back with renewed zest to that upon which he failed.

It will thus be observed that the keynote of the system is individual work by the pupil and individual attention by the teacher. Each boy is judged on his own merits, each boy's mistakes are pointed out to him by the instructors, and at the end of the course each boy carries home in triumph his own handiwork, whether it be only five models, or twenty, or thirty. As these models are all articles of service in a house, the maker and owner will see them in daily use with keen delight. In addition to the actual work with the tools, the boys are taught to make accurate drawings to scale of the models; and they are given practice in reading the drawings while making the models. Hence, at the conclusion of the course, the boy of fifteen can form an idea of an object he wishes to make, make a drawing of it, which could be read by any mechanic; cut out his wood and make the object exactly according to his drawing.

Now a word as to the purpose of this training and its relation to technical work, by which is meant the actual learning of a trade. Though, in any sloyd exhibit, the finished models are shown as an example of the work done, this is somewhat misleading. The object of sloyd is not to turn out finished models, but, by means of their work on the models, to train the boys in the manner indicated in a former paragraph on this article. The growing skill and ripening character of the boy is the true sloyd exhibit. It is hence absolutely essential to this system that the work of instruction should be done by trained teachers. "The worst teacher of sloyd is a carpenter," for the simple reason that his life-work has been the turning out of wooden articles as perfect as possible. His object in using a tool on wood, say in the construction of a box, is to turn out a good box; the aim of sloyd in having a tool used on wood in the same construction, is to turn out a good boy. Hence, after a lengthy trial of artizans, as teachers of sloyd, their services were totally dispensed with. Their attention was centred upon the finished object, and they could rarely abstain from actually helping the pupil at the critical point, thus undermining the qualities of honesty, independence and accuracy, which it is the very aim of the system to cultivate. Sloyd work is thus very different from technical work, or the learning of a trade. Sloyd is an educational subject, suitable for early school life. Technical work is of commercial value, suitable for boys who have decided on their future mode of life, and have come to years of strength and almost of manhood. At about sixteen years of age, one boy enters a dry goods store, another continues his studies in preparation for the University, a third is entered as junior in a banking or mercantile house, and a fourth enters a technical school to prepare for work as an architect, mechanical engineer, or carpenter. For each and all of these boys sloyd has been a most valuable school subject. Com-

mercial work in school is not valuable only for No. 1, nor literature only for No. 2, nor mathematics only for No. 3, nor sloyd work only for No 4. They are all school subjects and good for all boys alike.

The following facts, however, must be carefully noted: First, that should the boy who has studied sloyd decide to train as a carpenter, he will have nothing to unlearn, though many things to learn. He is not only a well trained boy mentally, but his new master will find him well grounded in the rudiments of his work, and well prepared to understand and carry out instructions; while the manner in which he has been taught to use tools is thoroughly scientific from the practical carpenter's point of view; and second, the fact disclosed by the following: An experienced English teacher found that 90% of his sloyd class was, on leaving school, entering a neighboring electric works. He asked the manager how he found them equipped for their work. The answer was that they could read drawings at sight, were trained to exactness in the fulfilment of orders, and, in fact, could in a month be trusted implicitly to carry out their instructions, where the non-sloyder needed a year. And yet in the school from which these boys came, wood alone was used as the working material. From these facts will be seen the position of sloyd in relation to technical training.

For readers who desire to inform themselves on this work, I would recommend Professor Robertson's address on "Manual Training in Public Schools;" and "The Theory of Educational Sloyd," by Herr Salomon, director at Naas. There will also appear shortly a series of articles on the work in Canada, illustrated with photographs of interest in connection with the subject.

ROAD BUILDING IN CANADA.

In a paper read last month before the Canadian Society of Civil Engineers, A. W. Campbell, C.E., instructor on road making for the Ontario Government, urges a good many points, which, though not new to the science, should be constantly kept before those concerned in street making. Mr. Campbell sensibly lays stress on those conditions in which the element of climate has to be considered.

"A dry subsoil," he remarks, "becomes of paramount necessity in a cold and humid climate, such as prevails throughout Canada for a considerable portion of the year. The injury done to roads by frost is caused entirely by the presence of water. Water expands on freezing, and the more there is under a road, and above the frost line, the greater is the injury. In freezing, the particles of soil in immediate contact with the water are first compacted. When room for expansion ceases within the body of the soil itself, owing to its saturated condition, the surface is upheaved. When thawing takes place, the subsoil will be found honeycombed, ready to settle and sink beneath traffic. It is, therefore, of the utmost importance that the soil should be relieved of all water of saturation as quickly as possible by underdrainage. The impassable condition of the roads during the spring, often axle-deep with mud, is to be attributed very largely to a wet subsoil, which has been honeycombed in this manner.

"The making of a strong foundation thus resolves itself into a question of underdrainage, and the means whereby proper underdrainage is obtained must be adapted to the manner in which water finds its way under the road, and the nature of the soil. A soil retains in its texture, by capillary attraction, a certain amount of water. In the case of plastic clay, which will absorb nearly one-half its weight and bulk of water, the water retained in this way may be the cause of injury. In the case of gravelly, sandy, or other porous soil, it is necessary to remove only the water held by hydrostatic pressure in the foundation of the road. The effect of this is, that with a clay subsoil, underdrains are nearly always beneficial in securing a strong foundation, and are necessary for traffic of even a moderate degree. With porous soils, on the other hand, the necessity and means of drainage will depend upon the height to which water rises in the foundation, and the direction from which it comes. When a strong foundation is needed, these underdrains should be three or four feet below the surface of the subsoil. Their location with respect to the road should be varied with circumstances. The most effective type of drainage employed is a system in which there is a tile drain on each side of the roadway, underneath the open gutters, with V-shaped drains at intervals, from the centre of the roadbed to the side drains. From this the scale descends to drains at the sides of the road only; then a drain at one side only, or in the centre of the road; then only an occasional drain at springy or damp points.

"It is of advantage to understand the manner in which the underdrains act in different cases. With porous soils, in which the water rises under hydrostatic pressure, the water enters the tile from below; just as water rising in a vessel finds an outlet in the side or flows over the top, so the underdrains supply the necessary outlet for this excess moisture at a proper depth from the surface; it 'lowers the water line.' With clay the process is different. Absorbing and holding, as it does, like a sponge, a large quantity of water, drains are less effective, but none the less necessary. The cracks and fissures which appear throughout the surface of a sun-baked clay soil during the summer drought afford a clue to the action of underdrains upon such a soil. As the clay yields up its moisture, it shrinks, is torn apart. These fissures, commencing at the drain, spread and branch in different directions, and each fissure thus becomes a new drain leading water to the tile. This process goes on, the fissures become filled with sand, vegetable and other porous matter, so that they assume a degree of permancy, and, in clay soils underdrainage is more effective after several years than at first. The metal covering placed over the earth foundation should perform two services. It should be waterproof, so as to prevent water from readily passing through and softening the subsoil; and it should form a smooth, unyielding, and durable surface covering to facilitate traffic and resist wear. The effectiveness of the stone covering as a water protection is increased by crowning the roadway so as to throw the water to side drains or gutters, which, in turn, carry the water from the road. The varieties of stone which bind most readily as a rule will form the better protection from water. But,

CONTENTS OF THIS NUMBER:

	PAGE
Acetylene in Germany	111
Burnham Automatic Feed Pump and Receiver	151
Calyx Drill, The	153
Can. Light & Power Co.'s Works	111
Canadian Society Civil Engineers	144
C.A.S.E. Annual Dinner	142
Catalogues, New	151
Chapman Voltage Regulator	152
Chimney, Toronto's Tall	144
Dominion Finances	139
Electric Flashes	146
Gold Milling, Free	139
Hays, Chas. M.	152
Imperial Trade Notes	154
Industrial Notes	145
Interprovincial Bridge, Ottawa	144
Literary Notes	143
Magnalium, A New Metal	111
Manual Training in Canada	135
Manzel Automatic Oil Pump	142
Marine Matters	148
Metal Imports	iv
Mining Matters	149
Nickel of New Caledonia	111
Personal	149
Rails	xv
Road Building in Canada	137
"Scottish King," The Floating of	154
Steam in Turbines, Superheated	iv
Zeppelin's Air Ship, Count	150

in order to be a good protection, the road surface must be smooth, without ruts or hollows, otherwise the flow of water to the gutters will be impeded. The water will then rest in the wheel tracks or depressions, will percolate through the surface, and traffic will immediately create injury. The stone, therefore, which binds readily, may not be a good covering, unless it is tough enough to resist wear and maintain a smooth surface. While the name stands for much, it is not a guarantee, by any means, of the usefulness of stone for road purposes, since each variety may vary much, even in the same quarry. The French Department of Public Highways has adopted a scale of 0 to 20, showing the quality of different kinds of stone. This list indicates:

Trap	varying from 16 to 20
Quartzite	varying from 11 to 19
Quartz	varying from 10 to 18
Limestone	varying from 5 to 17
Gneiss	varying from 5 to 17
Granite	varying from 3 to 16

"These rocks are among the most common in Canada, and the list serves to show the wide degree to which their usefulness for roadmaking may vary. Limestone is most frequently criticized, but French practice shows that it may rank among the best; while granite, so frequently extolled, may be very poor, indeed. Limestone, while it is very apt to be soft, is one of the best building stones, and for this reason a combination of moderate toughness with good building qualities may result in an excellent stone for a Macadam road. Trap is universally regarded as very reliable, since it combines both toughness with fair cementing properties. The difficulty with granite, on the other hand, is that, while very hard, it wears into a coarse, sandy material, which refuses to bind.

"The use of machinery in road-making is taking a prominent place, as in other branches of construction. Wheeled scrapers, road graders, rock crushers, with screen attachment, steam and horse rollers, are the more common. The grader is most useful on country roads of cheap construction, such as must serve a great proportion of Canada for a long time to come. The crusher is of less universal value, but it is gaining popularity wherever there is rock to be broken or coarse gravel or boulders to be treated. A heavy roller is becoming more and more regarded as indispensable in building a Macadam road, and the best results cannot be obtained without one. Unless a roller is used, the stone must be spread loosely on the road, and left for traffic to consolidate. This is a slow process causing much inconvenience to travel, and during which the earth and stone become intermixed. Earth mixed with stone, as previously pointed out, prevents the strong mechanical bond which clean metal will assume when the stones are wedged one against another. The particles composing this earth, in wet weather, too, move more readily around one another, the road surface is softened, and is more readily broken up. By the use of a roller, the earth subsoil should first be thoroughly compacted. Each layer of stone placed upon it should also be well consolidated. In this way a smooth, durable, waterproof coating can be laid over a firm foundation."

Of the kind of road rollers suited for different conditions, Mr. Campbell says:

"There are different kinds and classes of rollers. The horse roller, weighing six or eight tons, will do fairly well if a steam roller cannot be afforded, but the horse roller is not sufficiently heavy, and has to be used much longer on a given section than a steam roller to produce the best results. The feet of horses, in exerting sufficient strength to move the roller, sink into and disturb the road metal, and thereby injure the shape and quality of the roadway. There is danger, on the other hand, of having a steam roller which is too heavy. A very heavy roller will sometimes sink into light or loose soil, force it ahead, and create a mound over which it cannot pass; this, however, may sometimes be overcome by spreading over the surface of the soil being rolled, a thin coating of gravel. The same result will sometimes occur with an excessively heavy roller on a layer of loose stone. The heavy roller is more liable, too, to injure underground pipes, catch basins, culverts, bridges, or disturb sidewalks. For these reasons a roller exceeding 10 or 12 tons in weight in some localities, where the soil is of a loose or sandy nature, is frequently not desirable. In districts where the natural soil is gravelly or of stiff clay, a heavier roller may be operated successfully, but some municipalities have found it necessary to use a light horse roller in consolidating the subsoil and first layers of stone. Nor, if the stone used in the construction of Macadam roads is of a soft nature, is a heavy roller, say of twenty tons, desirable even in the finishing courses, as the crushing effect has been found in some cases to crumble and pulverize the stone rather than merely consolidate it. For new work, in which the dirt foundation must be rolled, a weight of twelve tons is generally the most serviceable; but for picking up an old roadway and reconsolidating it or for finishing a new work, fifteen tons is better. Where a municipality is to own only one roller, it will be advisable to consider very carefully the work to be done before purchasing a roller of over twelve tons' weight."

TOWARDS THE BREAKERS.

By the time this number is in the hands of our readers, the political destiny of Canada for some time to come will have been committed to the keeping of either the present Government or a new Conservative administration. The Canadian Engineer is not a political Journal, but one thing it feels called upon to urge, and that is that no matter which party comes into power, men of influence in all classes should protest against the reign of wicked extravagance that has begun in the management of Dominion affairs. What

would be said of a workman, who, having good wages in the summer, but none in the winter, was to live up to his wages as fast as he earned them, till all his earnings were gone before the first fall of snow, with no coal or wood laid in for the winter. He would be called an improvident fool with no pity or care for his family. Yet that is what our rulers at Ottawa are now doing. Industrial prosperity and expansion come in cycles, and Canada, having enjoyed three or four years of it, has already passed the summer solstice of its industrial activity. For some months past, the process of contraction has set in in Germany and France, and is beginning to be felt in some departments of manufacturing in Great Britain. It is only a question of a year or two before the same painful pinch will be felt in the United States and then in Canada. We hope that, as in the case of the last depression, it will not be felt so poignantly in Canada as in other countries—but felt in some degree it assuredly will be, and the present surplus of Dominion funds, now so light-heartedly flung right and left on needless railway bonuses, and political public works, will then be unavailable for works that would maintain the balance in favor of the unemployed, or for any other wise purpose, such as the reduction of taxation, or the national debt. While it is not good to prophecy of coming evils too often, it is folly to shut our eyes to the evidence of past experience.

Caution, care and conservatism should rule the plans of individual firms, as well as the Government for the coming two or three years. While we have nothing to say against new enterprises starting in lines that are inadequately represented, or not represented at all, or businesses intended to cater to the wants of our newly-settled districts, those who are plunging into lines of industry already equal to all the requirements of the country should remember the advice of Artemus Ward—pause and take a big think.

—The practice indulged in by many civil engineers employed by the Dominion and Provincial Governments and by some of our leading public institutions of taking private work appears to be growing to an extent that threatens the good name of the Canadian Society of Civil Engineers, in whose keeping the ethics of the profession rest. If a needy Government clerk is found doing work for private individuals, to supplement his earnings, a scandal is raised, or he is punished by dismissal. Should the line be drawn any tighter on a poor clerk earning $400 or $500 a year than upon a professional civil servant getting ten times the salary? The one may plead poverty as his excuse, and has no code of ethics to restrain him; the other stands condemned on both counts. A profession which prides itself on its sense of honor should see to it that its unwritten laws are not broken in matters in which, if the offender were a mere laborer in Government employ the punishment would be dismissal and disgrace. The practice referred to is growing to a serious extent, and is extremely unfair to the body of the profession, who make their living on their own professional merits, more especially as the private practice obtained by these officials is frequently taken on terms which could not be met by an engineer depending on his practice for a living.

—A correspondent informs us that mining operations are almost at a standstill in the Rainy River district. Few mines are working at the present moment, and none are paying except the Mikado. The reason for this is that the cyanide process is required to make the average grade of ore in this district pay, and none of the miners referred to have managers who understand the cyanide process. Under these circumstances, why should not a few of the idle mine managers of the Johannesburg gold fields—where the cyanide process is carried out in the most expert manner, and with the most up-to-date appliances—be imported to put these Rainy River properties on their feet?

FREE GOLD MILLING.*

W. Muir Edwards, Sc., 1901.

There are, as you know, two methods of treating gold ores for the extraction of their mineral wealth, depending on the state in which the gold is found, that is whether it is native or free gold, as it is called, or whether it is in chemical combination. It is in the treatment of the first and by far the larger class of gold ores, that milling is used. The process consists of powdering up the ore fine enough to liberate each particle of gold from the surrounding rock, and then by some means retaining the gold while the worthless rock is allowed to wash away.

We will now follow the course of gold from the time when, embedded in the waste rock it falls from the hands of the deck-hand into the crusher, until in a bar shaped mass it lies in the manager's safe ready for shipment to the bank. The process of which I will give a description is that in practice at the Dufferin Mines, Nova Scotia, where there is a 60-stamp mill in operation, which was just finished in September, and is certainly up to date in every respect. The ore from the mine having been separated from the worthless rock, which is necessarily mixed with it, is dumped into a grizzly or bar screen. This grizzly is formed of 1-inch by 1½-inch bars, inclined at about 45° to the horizontal, and set 1½ inches, in the clear, apart. Through it all the ore under 1½ inch size passes, and slides under the rock breaker to the rolls. The larger fragments of rock slide down the grizzly to the rock breaker. This breaker is of the well known Blake type, samples of which may be seen in the small crushers in your mining laboratory. The breaker reduces the rock to 1½-inch pieces, and these together with the pieces which have passed through the grizzly, fall by gravity to the Cornish rolls. A pair of these may be seen in the laboratory just behind Chalmer's two stamp battery, and so it is hardly necessary to describe them. From the rolls, which are set ⅜-inches apart, the rock falls into a skip, running on an inclined railway with an inclination of about 60°, by which it is raised and dumped into the ore bin.

In regard to the practical workings of this part of the mill I cannot speak with as much certainty as of the other parts, but I think the main troubles are as follows: In the first place the chief difficulty is the heating of the bearings, especially those of the cross shaft, upon which is hung the pitman of the rock breaker. If, however, these boxes are kept filled with tallow the latter will always melt slowly, and will keep the bearings sufficiently cool. In the second place the rock breaker often gets jammed with big rocks, in which case the deck-man, with a long rod, worked through an opening for this purpose, pushes the rock around until the jaws of the breaker get a hold on it. The only other noticeable part about the breaker, apart from its tendency to shake itself to pieces, is the fact that now and again pieces of dynamite come through the rolls. But although they have had a couple of explosions down at the Dufferin, as far as I know no damage has happened from this cause. So much for the duties of the breaker-man, who also runs the skip. It is a lonely job at best, and is paid for at the rate of $1.50 a shift. As they work night and day in the mill, and in the mine, too, for that matter, it is customary to say so much a shift rather than so much a day.

The rock from the skip on the inclined railway is automatically dumped into the ore bin by the rails widening out and allowing the front of the car to fall through, while the flanges

*A paper read before the Applied Science Society of McGill University, session 1899-1900.

or projections on the hind wheels are engaged by the widened rails. From the skip the ore falls into an adjustable shute by which it can be placed in any part of the bin. Along the bottom of each of the two sides of the bin there are six gates or openings, closed by iron plates running in slots and raised or lowered by geared mechanism.

One of the duties of the amalgamator who has charge of the ore from the time it comes out of these gates until robbed of its free gold it passes to the hydrometric sizers, is to see that just the right amount of ore feeds through them, and that they do not become blocked up with sticks, etc. From these gates the ore slides down inclined shutes to the automatic ore feeders. Those at the Dufferin are of the Challenge ore feeder type. That behind the Chalmer's two-stamp battery in your mining laboratory is of this type. From the ore feeders the rock slides to the batteries, of which it is hardly necessary to give a detailed description, as there is a battery of five-stamps in the laboratory. In fact in this paper I thought as you were all acquainted with the different machines, or if you had not already seen them, those interested could do so in your mining laboratory, that it would be more interesting to deal with the practical working rather than with the machinery. However, I will run over the names of the different parts of the batteries, of which some of you perhaps are not familiar. The term mortar is applied to the frame in which the crushing takes place. The die is the anvil, so to speak, on which the ore is crushed, the toe, usually of the same material as the die; chrome steel being used at the Dufferin and proving very satisfactory, forms the head of the hammer, and sets into the boss head, which in turn is fixed to the stem. On this stem between the lower and upper guides is keyed the tappet, by which the cam raises the stamp (this latter term includes the toe, boss-head, stem and tappet).

The ore is fed from the ore-feeder at the back, and the water lower down from pipes running through the back plate. The usual custom, I believe, is to feed the water from the top from a pipe running along the front. However, from all I could learn, the system of water feed at the Dufferin was very satisfactory. The crushed pulp escapes through a thirty mesh screen onto the plates, which are shown in the cross section. These consist of copper plates coated with quicksilver with which the fine particles of gold amalgamate, and so are retained on the plate.

It is only a portion of the gold which escapes from the mortar, and is amalgamated on the plates. Most of it is amalgamated and retained in the mortar itself. For this purpose a small quantity of quicksilver, about the size of a pea, is dropped into each mortar every half hour. The proportion of gold retained in the mortar varies directly with the finest of mesh, and the height of the outlet, and inversely with the quickness of drop of the stamps.

Except on "clean-up" days the chief duty of the amalgamator is of course the care of the plates. These when in use become coated with a covering of dirt or grease, which impedes and, if allowed to go far enough, would altogether stop the process of amalgamation. They are, therefore, carefully watched, and "dressed" when necessary—twice a shift was the usual thing. The "dressing" seems to differ quite a bit, three or four processes being tried during the summer. However, the final one consisted of, first, rubbing down the plate with a soft flannel or chamois, moistened with a very dilute solution of lye—a stream of clear water being allowed to flow down the plate meanwhile. This cleaned off any dirt or grease. The plate itself was then put in shape; amalgam being taken off or worked more uniformly over the plate, and fresh quicksilver added, if required, until the plate had attained the proper condition of softness. The judging of when this condition has arrived is a matter of long practice. The amalgam is usually cleaned off the upper plate every two days, and off the others at varying intervals. If the plate is not soft enough quick-silver is added, and worked into the plate by square pieces of rubber, about 3 inches by 1½ inches thick. The final process consists of distributing the amalgam uniformly over the plate by lightly smoothing it with a whisk.

The guides have to be watched to see that they do not get hot, and the cams must be kept cool, or else they will of course spit the rods. Ordinary axle grease is used on the guides both upper and lower, and a mixture of axle grease and graphite was found to work best on the cams. Tar does very well but is very hard to clean up, and axle grease is a little too thin. The guides are of the ordinary kind, using "side-on" wood. Two of the batteries have McDonald's patented guides, consisting of an iron frame and using "end-on" wood. The expression "side-on" wood is used to denote the fact that the stem works with the grain, and therefore parallel to the longitudinal axis of the stick of timber from which the wood is taken. The wood in a battery using "end-on" wood, is obtained by cutting a piece from the end of a large stick whose diameter is necessarily at least as great as the length of the guide. The stem in this case works across the grain and at right angles to the longitudinal axis of the timber. It would seem at first that more friction would be met with in rubbing across the grain than in rubbing with it; but, although this may be the case at first, the ends of the fibres soon become frayed, forming a surface like silk plush against which the stem works with very little friction. In fact McDonald's guides were found to work very well indeed. Candles are used as the lubricant in the cam shaft bearings; an occasional lump of tallow being thrown in.

The most frequent duty of the amalgamator, or usually his assistant, is to "hang-up." This consists of laying a stick, shaped for that purpose, and called the "hang-up stick," on the face of the cam before it engages the tappet, and thus raising the latter high enough to allow the jack to be placed underneath. Care must be taken to "hang-up" from the centre of each pair of batteries outwards. This puts out of the road the jacks against which the operator's hand might be thrown by the kicking of the hang-up stick. This kicking is due to the fact that the stick sometimes adheres to the face of the revolving cam; it may be remedied by the application of grease or tar to the underface of the stick.

Another source of annoyance is the blocking up, and even breaking of the screens. Often pieces of wood get into the mortars and interfere with the proper working of the batteries, and sometimes if the ore is feeding too fast the screen is broken, allowing unpulverized material to escape. If the amalgamator does not notice this himself, however, he will soon be informed of the fact by the vanner man.

The only other work which is of fixed occurrence, so to speak (I mean that it comes on account of the working of the batteries, quite apart from accidents), is the shifting of tappets to keep the drop constant. As may be easily seen both the shoe and die wear away, and if the tappet were not shifted up the drop would become too large. Again sometimes the tappet gets shifted up the rod, by the blow of the cam, I suppose; and has to be moved down again. If the tappet has to be shifted down the stamp is raised by the overhead crawl, and the keys having been knocked out the tappet is then hammered into its position. If it has to be shifted up the keys are loosened, and the stamp allowed to work, the cam gradually knocking the tappet up the stem until it is in the desired position.

Another important duty of the amalgamator is taking the samples of the battery tailings. These are collected every hour with a cup on the end of a rod and a bucket, the tailings being allowed to settle for an hour and then the liquid poured off and a fresh lot taken on top, and so on. The tailings of each shift are assayed, and from these assays together with the assay of the rock, some idea of the efficiency of the batteries is obtained. They also serve to check the vanner results.

The most interesting and also the busiest day in the mill is that on which "clean up" takes place. It is usually on the 1st and 15th of each month. The mortars are cleaned up, two at a time, the rest of the stamps being allowed to run. The first step is to thoroughly pulverize the rock in the mortars by stopping the feeding of rock while the stamps are allowed to run for a short time. The water is then turned off and the stamps "hung up," care being taken to see that the jacks are quite firm. The plates are then scraped and dressed and planks are put across them to allow the men to work at the mortars. Pieces of wood are then fixed across the bottom of the plates to prevent the coarse material running off to the vanners. The front of the mortar is then opened up, the loose gravel and sand on top shovelled into tubs, and the dies, having been pried loose, are lifted out, and all the adhering material thoroughly washed off onto the plates. They are then set to one side, and the crushed ore, which has been packed around them, is either put through the next battery or else taken and dumped into the

mixer. This is a large iron bowl with a sort of paddle revolving in it, which thoroughly mixes the crushed material. If the two mortars are those first to be operated upon then this material is taken and dumped into the feeders of the other mortars, and so finally, in the last two mortars a very much greater degree of concentration is reached, and so less material has to be panned to yield the gold crushed out by the thirty stamps.

After the ore is removed the inside plates of the mortar are taken out, and the amalgam removed from them, and then the inside of the mortar is thoroughly washed down with a hose, and these washings removed. The water pipes are then tested, the amalgam plates put back, and the wear of the toes and dies examined, and if necessary new ones substituted. Then a thin bedding of the loose gravel which was first taken from the mortar is laid on the bottom, and the dies are placed on it, and then the mortar is filled up level with the top of the dies with the rest of this gravel, and the front of the mortar closed. The pebbles, etc., which have collected against the obstruction at the foot of the plates are removed, and dumped into one of the other mortars. The planks are finally taken off, having been first thoroughly washed, and the plates, which by this time are rich in amalgam, are then scraped with rubber scrapers, and knives, if necessary, and then dressed down, and the battery is ready for another two weeks' work.

So on for the other batteries, until after a hard day's work all of the free gold contained in the ore passing through the mill for the last two weeks is collected either as pure amalgam in the scraping dishes or concentrated in a comparatively small amount of gravel. This latter is extracted next day, formerly by panning, but a few weeks before I left the mill superintendent rigged a sort of shaking cradle which if run with care gave very close results. The waste from the concentration is again put through the batteries so that no particle of gold can possibly escape. The amalgam panned or cradled from the crushed rock, together with that taken from the plates, is put in a piece of chamois, which is then twisted very tightly; thus squeezing out any superfluous mercury, and leaving a hard, compact ball of amalgam.

At the beginning of each month the result of the last two "clean ups" is smelted into a gold brick, varying in size. The amalgam is first heated in a retort sufficiently to evaporate off the mercury, which passes off through a condenser and is caught for future use. The gold sponge is then melted down again and run into a mold. It is then weighed in the presence of both the manager and the mill superintendent, and is then shipped to the bank.

You will remember that the pulp from the mortars passes over the plates, the free gold being retained on them, and the rest of the pulp passing to the hydrometric sizers. The water rising in these currents of varying intensity, separates the crushed material into different lots, the particles of which have about the same velocity of fall through water. These principles you are now thoroughly acquainted with, so that it is quite unnecessary to touch them. Pipes lead the pulp from each of these sizers to a vanner especially fitted for it. The vanner is a concentrating machine, consisting of an endless rubber belt inclined, and having a side shake, identically the same as the ones to be seen in the laboratory. The vanners are classified as number 1, 2, 3 and 4, according as they treat tailings coming from number 1, 2, 3 or overflow of the hydrometric sizers.

Each set of vanners has a special velocity of side shake; the number 1's, which treat the heaviest particles, about 200 to the minute, varying to the number 4's, which shake at the rate of about 100. The inclination and forward drive of the vanner varies with special conditions; the members of each class, i.e., the number 1's, having approximately the same, there being always some slight individual difference. You will understand that the vanners themselves are all exactly alike—the difference in the side shake being accomplished by differences in the overhead pulley from which the vanner drives, while the difference in inclination and forward drive is obtained by adjustments on the vanner itself. So that a No. 1 vanner could replace a No. 4, if the driving pulley was changed, and the adjustments altered. The shaking motion is of course fixed, and has no adjustments but the forward drive, the inclination having once been fixed, varies to suit different conditions. The water feed is kept constant, just enough being allowed to flow to make a thin, even film of water below the head; varying conditions of the concentrates being provided for by the forward drive only. A set of twelve vanners will keep a man busy all day, mending small breakages and adjusting the apparatus. The most frequent occurrence is the breaking of the rods, of which you are made aware by the noise. A curious thing about the mill is that, although you have to shout in a man's ear to make yourself heard you are at once aware of any foreign noise.

The hydrometric sizers also become frequently blocked up. This is usually due to a break in the battery screen, allowing too large pieces to come through. They are cleaned out with a hose, it being usually necessary to get fairly wet before the process is through. The belts have a tendency to run off the roller, either to one side or the other, which has to be remedied, and the water feed has to be watched carefully. Unless the water supply is particularly pure, on account of the comparatively slow feed, the pipes are continually getting blocked up.

The amount of pulp fed to each vanner is regulated by a pinch cock on the rubber hose just below the sizers. It is of no fixed amount, individual judgment alone determining how the pulp from the two five-stamp batteries shall be distributed among the four vanners.

The concentrates are cleaned out of the boxes twice a week, being first weighed, 200 lbs. at a time, and then taken out in a wheel-barrow, and dumped on to a pile to await future treatment. At the door a tablespoonful is taken from each wheel-barrow for assay purposes; so that with the weighing and sampling they have a very close idea of the amount of gold contained in their pile of concentrates. Samples of the vanner tailings for assay purposes are also taken every hour, just as with the battery tailings, and the efficiency of the vanners judged thereby. The tailings from the vanners fall into a slightly inclined trough down which flows a stream of water, and are thus carried out of the mill. I venture to say that only a very small percentage of the gold originally contained in the ore is carried off in these tailings.

The mill, as I have already said, is a 60-stamp one, the stamps being 1,000 lbs. each, dropping 6 inches 100 times a minute, and is capable of handling 200 tons of ore every 24 hours. The machinery is run by a 250-h.p. Compound Corliss engine. The staff consists of a mill superintendent, four amalgamators, four vanner men, two engineers and two oilers. These are divided equally into two shifts, one-half doing day shift for a week and then next week doing night shift. There are also two battery-man's assistants, who only work day shift, and do not work Sundays. The mill runs night and day, Sundays included. All of the necessary work is done on day shift, the night shift men only having to see that everything is working properly, take up the tailings, etc., and keep awake.

The work in the mill is comparatively light, although the hours are long and the night shift trying. However, if any of you get a chance to put in a summer in a stamp mill I think you will agree with me that it has been a very interesting and profitable summer's experience.

—John B. Smith & Sons, Toronto, have installed an equipment of compressed air hoists in their saw mills and lumber yards, ranging in capacity from ½-ton up to 4 tons. So far as can be ascertained this is the first application of this mode of handling lumber in Canada. Since its inception a great saving has been effected. For example, an ordinary load of lumber can be loaded or unloaded by two men in from 20 to 40 minutes less time than formerly. In handling the heavy lumber arriving in their yards by trains, less men are required, and a system of overhead tracks permits the lumber to be put right alongside of the machinery in the mill, with the one handling. In a plant of this kind the fuel being so plentiful the first cost is almost all to be considered. The air is compressed in the ordinary way, and is stored in a central tank, and distributed to auxiliary reservoirs. The rubber hose used is coupled at convenient points with automatic valve couplings, which permit of the hose being detached, and as soon as this is done the valve prevents any loss of air, thereby the hoist retains its load for any length of time necessary for its removal to other parts of the yard or building by the trolley overhead

MANZEL AUTOMATIC OIL PUMP.

The makers of the Manzel Automatic Sight Feed Cylinder Oil Pump claim that it is one of the best adjuncts of the modern steam engine. It is our old friend the sight feed lubricator in a new guise. The Manzel pump is really a single acting plunger pump with ball check valves. The pump plunger is operated by a disc crank (see Fig. A.), which is driven by a noiseless ball ratchet (see Fig. B), a small rod connecting the ratchet lever to the motion work of the engine. Fig. A shows the ball brake which prevents the friction wheel from backing up with the ratchet. Between the reservoir and the pump barrel is the sight feed glass (see Fig. C), the feed is controlled by an adjustable screw valve at the top of the reservoir; this valve once adjusted requires no more attention as it does not require to be turned on and off night and morning, since no oil feeds when the pump is not working. The reservoir has a full glass body and the oil can be seen in it from any point in the room. It is filled through a strainer screwed in the top, which is open all the time and can be filled without soiling or burning your fingers and without the aid of wrenches. There is no pressure on the reservoir or sight feed glasses, consequently they are not likely to break and make a "mess" of everything. There is a hand crank attachment (see Fig. D), by which the pump may be operated, if a little extra oil is required at starting up, making it a hand pump and sight feed lubricator in one. These pumps are made single, double, triple, quad, and sextet. With any of the multiple pumps any pump can be shut off all together or made to feed at any rate without reference to the others. In compound and triple expansion engines or pumps the proper quantity of oil can be fed to each cylinder without interfering with the others. They have shown on tests a saving of from 30 to 60 per cent of oil. These pumps also make an excellent means of feeding compound to a boiler, as they can be attached to the feed pump, and will feed a small quantity of compound at each stroke of the pump, thereby treating the water continuously and in the proper proportions. There is a special pump made for horseless carriages that is unique for this purpose, a lady can fill it without soiling her hands or the carriage. The makers claim for these pumps that they are perfectly automatic, will start to feed oil when the engine starts, and will stop when it stops. The Manzel pumps are being put on the market in Canada by the Steam Specialty Co., 43 Wellington street east, Toronto, who are the Canadian agents. They have placed a number of these pumps in the city, and will place them on trial with responsible parties.

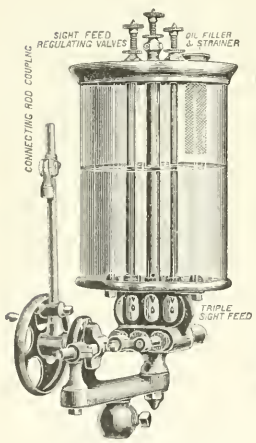


Fig. D—Triple Feed Pump.

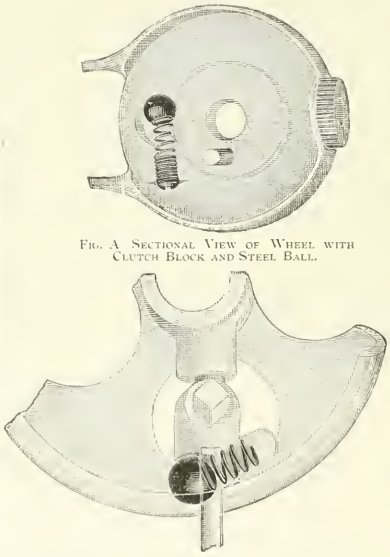


Fig. A Sectional View of Wheel with Clutch Block and Steel Ball.

Fig. B—Sectional View of Ball Brake and Piston Guide.

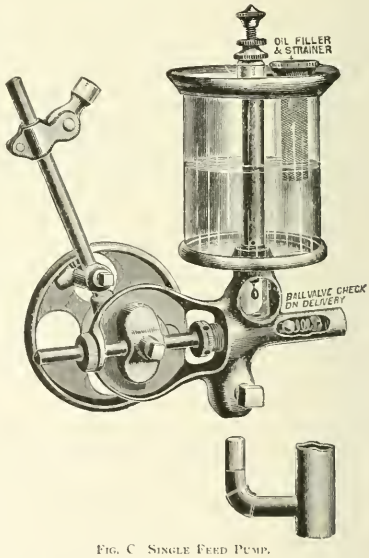


Fig. C Single Feed Pump.

ANNUAL DINNER C.A.S.E.

The branch of the Canadian Association of Stationary Engineers, known as Toronto No. 1, always has a successful gathering at its annual banquet, and the fourteenth, held at the Walker House, was no exception. President Jas. Huggett opened the proceedings with the aid of a regulation gavel and the support of members of the Executive. His remarks were along the line of progress made by individuals under the educational wing of this particular branch. Better men earning better salaries. These statements were backed up by the presence at the table of those benefited, and made the speaker feel proud of the honor they had conferred on him by his election as president. W. J. Webb, the secretary, read letters of regret from City Engineer C. H. Rust, and others prominent in engineering circles.

The toast of "Canada Our Home," was responded to by ex-Mayor Shaw, who has for many years been a guest of this association's annual banquet. He did full justice to Canadians as a patriotic people, their success in all walks of life, reference being made to our troops in Africa, also the defeat of Conan Doyle by a Canadian in the Old Country parliamentary elections; and expressed a hope for future prosperity. An appropriate song, entitled "Sons of the Empire," was rendered by Mr. Gilloogly. "Toronto Our City," was responded to by A. M. Wickens, who in the absence of several aldermen who had been invited and failed to keep their engagement, claimed that it was hardly possible for him to do what five aldermen had been expected to perform. He made a few remarks in eulogy of Toronto from a residential standpoint, and as the possessor of the only free technical school in the world, the new home of which was a fitting monument to the enterprise of Toronto's citizens.

"The Manufacturers." This toast had two respondents, Geo. R. Baker of the firm of Westman & Baker, manufacturers of printing machinery, spoke of the great prosperity of the Canadian manufacturers, and his own business, while not protected by a high tariff, had during the last four years tested severely the capacity of their plant. Reference was made to the great changes in machinery since the speaker had gone as an apprentice to the shops. The hammer and chisel of old practices in modern practice had been replaced by automatic machines which enabled them to do better work at a smaller cost and a larger production. In a few words he told of the goods Canada could supply to the outside world; he referred to the speedy proof of her capacity to manufacture good soldiers, and for a country made up of so many nationalities she had done remarkably well.

J. J. Main, on rising to speak, was greeted as an old friend, and it was some minutes before the enthusiasm had subsided enough for his voice to be heard. The speaker had been present at eleven of the fourteen annual banquets. He had always enjoyed good times as a manufacturer. Canada as a manufacturing country would be heard from, and from all parts of the world enquiries as to what Canada could produce were coming in. Old conservative ideas were being done away with, and as a proof he mentioned the introduction of pneumatic riveting machinery into his own works, where its arrival was almost the cause of a strike. They had more work than they could get men to perform, and for eight months had been working day and night. The speaker then told several of his anecdotal stories to the great enjoyment of the audience.

"Educational Interests" were responded to by E. J. Philip and A. M. Wickens, who both received a flattering reception. The first speaker described the benefits received by him from the society, and later on by courses from correspondence schools, and he was pleased to know that Canadians were enterprising enough to start a correspondence school in Toronto. The two speakers were on the staff of the Canadian correspondence school, and although starting in a small way, and with a limited number of courses, they felt it would be a great success. A. M. Wickens felt as if no subject was dearer to his heart than that of education, and in his capacity of executive secretary he had under way educational papers which the association hoped would be a great help not only to the members but to outsiders anxious to learn, and anyone who wished to be successful in the steam engineering and kindred lines had to study, and the association was prepared to do its share by supplying the necessary subjects for study. The Executive was responded to by Chas. Moseley, Toronto, and R. C. Pettigrew, Hamilton. Sister Societies, by A. E. Edkins and O. P. St. John for the O.A.S.E. "Our Host," the manager of the Walker, replied in a few well chosen words. Amongst other invited guests there were the following: John Gourlay, J. M. Bannon, H. E. Terry, G. C. Mooring, G. F. Haworth, Jas. Lester, John Fox, J. G. Bain, A. E. Stover, Hedley V. Short, W. P. Sutton, W. Anderson, Geo. Bradley, John Shales, G. T. Pendrith, W. Phillips, H. Truesdale, N. V. Fuhlman, Geo. Grant, W. S. Outhwaite, Geo. Thompson, Geo. Gilchrist, J. M. Sinclair, W. Gore, Jas. Mooring, T. Eversfield, T. S. Young of the Electrical News, and Arch'd. W. Smith of The Canadian Engineer.

LITERARY NOTES.

The Blue Book of American Shipping for 1900, just issued by the Marine Review Publishing Co., Cleveland, O., makes a solid volume of 485 pages, and gives information of United States and Canadian steam and sailing vessels, mentioning the name and style or rig of the vessel, the gross and net tonnage, the length of keel and width of beam, when built, and the name and address of the owners. It gives a list of the captains and marine engineers of the Great Lakes, coasts and rivers of the United States, and a fairly complete list of those of Canada; and besides other lists relating to marine business it contains a directory of ocean steamship lines plying between United States and foreign ports, and a mass of marine statistics of much value to those interested in shipping. It also has illustrations of types of American vessels of nearly every kind, from sailing yachts to men of war. The frontispiece is a colored engraving of the new battleship "Maine." Altogether the Blue Book is a most valuable work of reference.

The October number of the Newfoundland Magazine is the best of that interesting new periodical yet issued. "Sea Devils in Newfoundland Waters," is an instructive sketch of one of the remarkable fish to be found off the coast of Newfoundland. H. W. LeMessurier gives a readable account of Newfoundland's past trade with Spain, while D. W. Prowse entertains us with a bright sketch of grouse shooting. The fiction and poetry of this magazine is much above the average. The subscription to this excellent periodical has been reduced to $1.50 to foreign subscribers, or $1 to domestic subscribers. It is not apparent whether Canadian subscribers come under the domestic rate, but in either case subscribers will get more than their money's worth.

The Imperial and Asiatic Quarterly Review for October has three instructive articles on the Chinese question, and three equally instructive articles on India, one dealing with the religious aspect of Indian education, one with Indian agriculture, and another on the land policy of India. There are also a number of letters and notes on India and Africa, with articles on Central Africa and Uganda. Published at the Oriental Institute, Woking, Eng.

Queen's University Journal for October 20th contains a full page portrait of Principal Grant, with a view of the University buildings, and portraits and biographical sketches of the leading professors of Queen's.

The Canadian Magazine for November commences Vol. XVI., and has more than the usual variety of contents. James Bain, librarian of Canada's best public library, tells us a good many things not commonly known about the principal libraries of the Dominion. The article concludes with a list of the libraries, from which it appears that out of a total of 512 public and institutional libraries in Canada, Ontario has 430, Quebec, 41; Nova Scotia, 9; New Brunswick, 6; British Columbia, 5; Manitoba, 4; Prince Edward Island, 2, and the Territories, 1; besides which there are five Government libraries. These 512 libraries have a total of 2,420,577 volumes, of which total a little more than half are in Ontario. A great deal of contemporary political history is to be found in A. H. U. Colquhoun's story of "Eight General Elections," and another good article is a sketch of A. G. Racey, the Canadian cartoonist, with samples of his work, by F. Clifford Smith.

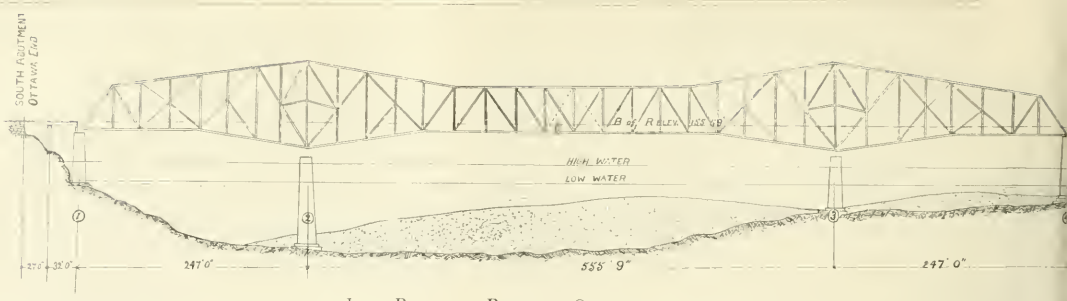
The Engineering Times has furnished a work that will be much appreciated by engineers who wish to know the leading features of the machinery section of the Paris Exhibition. This is in the form of a special number of the paper, in which a review is given of many of the best engineering features of the exhibition. It does not pretend to be a complete description, but its sketches, aggregating over 200 pages, are filled with most instructive matter relating to the machinery, engines and engineering appliances shown at Paris, and we are not surprised to learn that two editions have been exhausted. The engravings are numerous and many of them of the highest class. Published by P. S. King & Son, Great Smith street, Westminster, S.W., London, Eng.

No. 11 of the Educational Review's readings in Canadian history has been issued. The contents of this number are: Newfoundland of to-day, by Rev. M. Harvey; Canadian nobility of the French Epoch, by F. G. F. deFronsac; Geological History of the Bay of Fundy, by Prof. L. W. Bailey; the First Martyr of the Canadian Mission, a poem, by W. O. Raymond; Responsible Government, by Dr. James Hannay, and the Captivity of John Gyles, by Victor H. Palsits. Under the wise editorship of Mr. Hay, these pamphlets should have a wide sale among Canadians who value the history of their own country. Published by G. U. Hay, St. John, N.B., at 10 cents per number.

The "Inidikil System of Weights and Measures" is the title of a pamphlet by A. Lincoln Hyde, Ph.B., of Cleveland, O., on a decimal system of weights and measures, which he proposes, based on the English inch. It is ingenious, and has some points of superiority to the metric system, but it does not get over the objections urged against the metric system by engineers—namely, that it lacks the advantage of readily getting at halves, quarters and other even numbered fractions and proportions.

A new edition of Richard Brown's "Coal Fields and Coal Trade of Cape Breton" has been got out by R. Drummond, publisher of the Maritime Mining Record, Stellarton, N.S. This standard work on the Cape Breton coal fields has been out of print some time, and the need of this reprint has been proved by its rapid sale, as the new edition is already nearly exhausted. The editor has added a large amount of recent information in three appendices, bringing the work well up to date. The price of the book is $1.25.

High-speed Steam Engines, by W. Norris, A.M.Inst. of C.E., M.I.Mech.E., and Ben. H. Morgan, editor "Engineering Times," published by P. S. King & Son, Great Smith street, Westminster, London, Eng. The object of this work is to give the best known practices in high speed steam engineering, based on actual work rather than on theory. The work is founded almost exclusively on the performances of engines made in Great Britain. It contains 146 pages with 115 illustrations.



Inter-Provincial Bridge at Ottawa.

THE INTERPROVINCIAL BRIDGE, OTTAWA.

We give herewith an outline sketch showing the general dimensions of the new Interprovincial bridge across the Ottawa river at the Capital. In addition to this there is on the Ottawa side a three-track railway trestle over St. Patrick street, 300 feet long, and on the Hull side six plate girder spans each 56 feet long, over the different street openings. Starting from the Ottawa side the main bridge consists of two 30-ft spans, a central cantilever span of 555 feet 9 inches, with its anchor arms, making a total length of 1,049 feet 9 inches, a fixed truss span of 247 feet, one of 140 feet, a combined railway and highway trestle 390 feet long, and a single track trestle with the bridge over Laurier avenue, 404 feet long. The cantilever and truss spans over the river have trusses spaced 24 feet apart, centre to centre, with provision for a single line of steam track and two sidewalks between the trusses. There are cantilever brackets 19 feet long on each side of the trusses, which carry the two lines of electric railway track and the roadways for vehicles. The bridge was designed in accordance with the 1896 specification of the Department of Railways and Canals, the locomotives of class 1 being taken for the steam railway, but the following load being taken at 3,000 pounds per lineal foot. In addition to this, provision was made for a train of electric cars on each track, 120 feet long, weighing 1,000 pounds to the foot, and for a highway load of 40 pounds per square foot, all the sections being computed at railway unit stresses. The brackets and details of the floor system were figured for a 13-ton road roller, and a live load of 70 pounds per square foot of floor surface in addition to the electric car load before noted. This important work has been carried out by the Dominion Bridge Co.

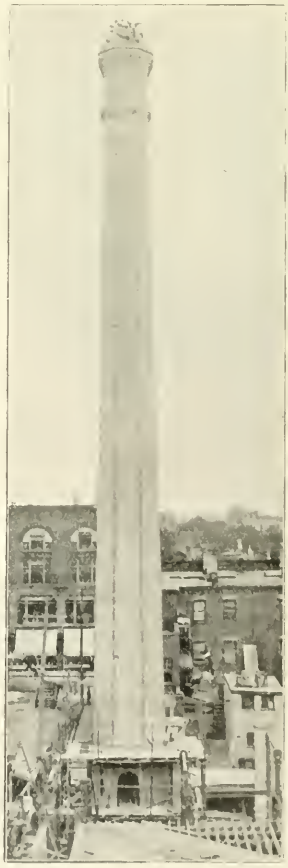
CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the meeting of the above society on the 25th October, a paper, referred to elsewhere, was read on "Road Construction and System of Control," by A. W. Campbell. A discussion took place on Mr. E. Marceau's paper, on "The Carillon Canal, Dam and Slide." The council has decided to call the annual meeting for Thursday, January 24th.

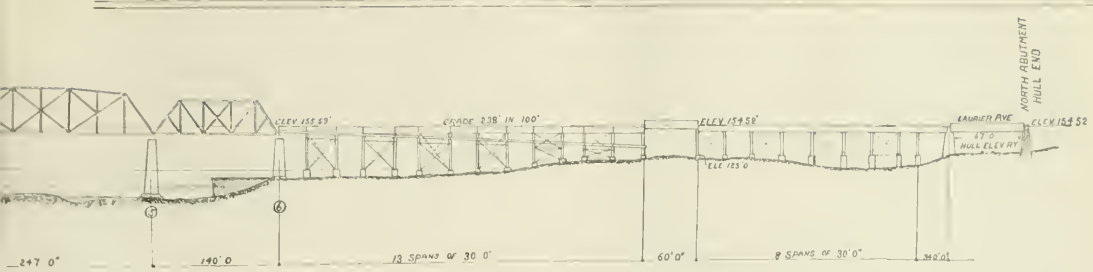
TORONTO'S TALL CHIMNEY.

The accompanying illustration shows the chimney for the reconstructed power plant of the T. Eaton Co.'s departmental store, Toronto. The concrete base is 30 feet square, 6 feet in depth and contains 200 cubic yards of concrete upon which two fifteen inch courses of "Longford" dimension stone were laid. The chimney base of brick is octagonal in shape, and measures 21 feet at the bottom and tapers to 16 feet at the upper part. The flue is 7 feet inside diameter. The chimney is 175 feet high, and has an inner lining for about 50 per cent. of its height. The wall of this lining is 18 inches thick, the inner 4½ inches being firebrick. The outer wall at base is 31½ inches thick, and at neck ring 13 inches, finishing at the top with the original thickness of 31½ inches. The original intention of the designer was to use a cast iron cap on the top, but the failure of the foundry to supply same in the specified time necessitated the using of one made from Portland cement. Portland cement (Star brand) was used extensively in the construction, the brickwork of the base being all laid in it, and it was used all the way up, with the mortar, in varying proportions.

The chimney was built to overcome certain local conditions and to overcome difficulties which its peculiar location demanded. Situated in the heart of the busy portion of the city, adjacent to fine public buildings, it had not only to occupy an assigned position but to provide for an increased demand in the future. This was no easy task for the designer. First of all the heat and power, for which the plant is designed, is no less than two blocks away, the steam from the time it leaves the boiler and returns travelling over 1,600 feet. The mains in



which the steam is carried pass under two streets by a passenger subway. The chimney can provide draft for a battery of boilers of 2,000 h.p. Over 255,000 bricks were used in its construction, and its approximate weight is 1,400 tons. Its designer was F. J. Philip, whose article on chimney construction appeared in our October issue, and who personally superintended its construction during the five months from its start to finish.



Built by Dominion Bridge Company.

Industrial Notes.

Joseph Bowman, Dundas, Ont., has the contract for the new armory for that town.

The C.P.R. proposes expending $400.000 in improving their workshops in Winnipeg, Man.

The Herelle chocolate works at Longueuil, Que., are to be enlarged to double their present capacity.

James G. Bailey and John Underwood have registered as the Bailey-Underwood Co., machinists, New Glasgow, N.S.

The Napanee, Ont., council will in January submit a bylaw to raise $45,000 with which to purchase the waterworks there.

The Ottawa branch of the Sir W. C. McDonald manual training schools was opened last month by the Governor-General.

M. D. deLery Macdonald, mayor of Rigaud, Que., intends to develop the waterpower at Point Fortune for pulp, lumber and other industries.

Jenkins Bros. valves are now carried in stock by the Steam Specialty Co., Toronto, who have recognized a demand for this standard make of goods.

The Steam Specialty Co., Toronto, have placed Bundy exhaust heads lately with J. B. Smith & Sons, Polson Iron Works, and the "Telegram," Toronto.

J. C. Wilson & Co., Glenora, Ont., find that their machine dressed gears are in good demand. They report a very large increase in this line during the present season.

A new 60-foot subway is to be built in Winnipeg to cost over $120,000. The C.P.R. and the city are bearing the expense jointly. The city's share is $60,000.

Willis Chipman, C.E., Toronto, has been engaged by the council of Iroquois to examine their present waterworks system, prior to the arbitration which is now pending.

D. Crichton & Son have started a foundry and machine shop at Lethbridge, N.W.T. The furnace has a capacity of three tons. The plant will be driven by a 14-h.p. boiler.

A new bridge is to be built at New Westminster, B.C., by the Dominion Government. The channel of the Fraser river is to be improved to make it navigable for vessels of all classes.

Charles Lionais, C.E., of Montreal, made a sale of an iron pyrites mine at Garthby, on the Quebec Central, to a New York syndicate, who propose to erect a sulphur factory at Levis, The company have already begun operations at the mine. The town of Levis will be asked for a bonus.

Cowan & Co., Galt, manufacturers of woodworking machinery, etc., recently opened an addition to their works. The new building is 60 by 36 feet, two stories high, the ground floor being a fitting shop and the upper flats a pattern shop and drawing office. In the spring the company will build a new boiler shop about 100 by 80 feet.

C. J. Rockwood, attorney, of Minneapolis, has been in consultation with Mackenzie & Mann regarding the development of the water power at Fort Francis for pulp mills and other works. The arrangement depends on the granting of a lease of the shore rights, on the Canadian side, from the Ontario Government.

John Brown, E. H. Morris, E. E. Rowe, Warsaw, N.Y., W. M. Davidge and T. H. Paterson, Niagara Falls, N.Y., have been incorporated as the Thorold Pulp Co., Ltd.; capital, $30,000; head office, Thorold, Ont.

The Ontario Wind Engine and Pump Co., Ltd., has increased its capital from $40,000 to $100,000. The company had been authorized to manufacture and deal in gasoline engines, brass, malleable iron and steel-castings and masts, and to galvanize metals.

Kingston, Ont., ratepayers have voted in favor of a grant of $50,000 towards a new Arts and Science building for Queen's University. It is stated that $150,000 will be spent in the next two years in buildings, apparatus, etc., so that from 1,000 to 1,200 students can be accommodated.

The Consumers' Gas Co., of Toronto, has 251 miles of mains laid, and the output of gas for year ending 30th Sept. was 838,215,000 cubic feet, an increase of 62,289,000 cubic feet over the previous year. The company will put in new plant to enable it to increase its daily production by 1,280,000 cubic feet.

Sales of "Bundy" steam specialties made during the last few weeks by their agents, the Steam Specialty Co., of Toronto, included the following. The London Heating and Ventilating Co., one tank steam trap; the T. Eaton Co., Toronto, two high pressure separating steam traps, and one return trap for Jas. Morrison Brass Mnfg. Co., Toronto.

Manzel Bros., Buffalo, whose automatic sight feed oil pumps are described in another column, have appointed the Steam Specialty Co., Toronto, selling agents for Canada, and their pumps are in good demand. The Linde British Refrigerating Co., Robb Engineering Co., Northey Mnfg. Co., Board of Trade, Toronto, having placed orders for same lately.

J. W. Bowden & Co., 67 Adelaide street east, Toronto, have furnished the following parties with Talismanic belt clinch: Grand Trunk Railway system, Montreal Street Railway Co., Christie, Brown & Co., Toronto, Jas. Stewart Mnfg. Co., Woodstock; Thompson Paper Mills, Napanee; Parmenter & Bullock, Gananoque; Ottawa Car Co., London Machinery Co., and others as well known.

J. W. Bowden & Co., of Adelaide street east, Toronto, report an ever increasing demand for "Talismanic" rubber facing from concerns using rubber belts, and who store same during part of the year. The belt before being rolled up and put away is heated with the preparation, which prevents it from cracking or becoming hard, and when the time comes for putting it in service it is found just as pliable as a new belt.

At Sault Ste. Marie another great centre of electro-chemical industry is springing up. A company has been organized with a capital of $30,000,000 to develop the water power on both the Canadian and United States sides. On the Canadian side 14,000 h.p. are now being used, while 10,000 h.p. will be taken by the American Alkali Works, and other industries, such as nickel reduction works and chemical works, are contemplated.

The Jenkins Bros. have put on the market at the request of a large number of users of their '96 sheet packing, a gasket tubing, which is made from a compound somewhat similar to their '96 packing. They have been extremely careful in the preparation of this gasket tubing, and feel confident it will meet with instant favor with steam users. It is made ¾ inch, ½-inch and ⅝-inch diameter in lengths of about 12 feet. Packed in boxes weighing from 4 to 6 lbs., and samples will be sent on application.

W. H. Wright, Buffalo, N.Y., A. C. Mathews, W. B. Powell, R. C. Smith, C. Ledoux and W. H. Laurie, Montreal, are applying for incorporation as the Wright Taper Roller Bearing Co., Ltd., to manufacture bearings known as the Wright Taper Roller Bearings, applicable to railway cars, street railway cars, drays, carriages, bicycles and vehicles of all kinds, and to shafting; chief place of business to be Montreal, Que.; capital, $300,000.

J. H. Still, sr., J. H. Still, jr., Annie C. Still, Alice E. Still, Margaret M. Still, Bessie McKillop, Mary McKillop, Geo. Pettit, St. Thomas, Ont., are applying for incorporation as the J. H. Still Manufacturing Co., Ltd., to manufacture wood handles, woodenware, tools and agricultural implements; capital stock, $99,900, $80,000 of which is paid by the transfer to the company of the business of James Henry Still, sr.; head office, St. Thomas, Ont.

A course of instruction by mail in chemistry is announced by the International Correspondence Schools, Scranton, Pa. The course includes mathematics, physics, theoretical, inorganic and organic chemistry, qualitative and quantative analysis. George Herman Dimpfel, Ph.D., who is in charge of the chemistry course, is a graduate of the University of Leipsic, Germany, and also studied in the Universities of Strassburg and Heidelberg. Later, he was an instructor in the latter institution, but was induced to take up commercial work, and after an extended experience in European cities he came to America, and is now Principal of the School of Chemistry.

The Cling-Surface Mnfg. Co., of Buffalo, whose belt-preservative, Cling-Surface, has been so prominently brought to the notice of the steam engineering people, have appointed the Steam Specialty Co., of Toronto, as agents. There is and has been a good demand for an article of this description, and the following concerns are using it, it is claimed with satisfactory results: St. Mary's Electric Light Co., St. Mary's; Toronto Electric Light Co., Barclay, Clarke & Co., O'Keefe Brewing Co., J. B. Smith & Sons, John Inglis & Sons, Polson Iron Works, Pure Gold Mnfg. Co., the Jas. Morrison Brass Mnfg. Co., and others which space will not permit mentioning.

The Cyclone Grate Bar Co., Ltd., of Toronto, having secured patents in all the European countries, and also in the United States, Australia and Japan, have sold the Ontario and Quebec province patents to a syndicate, at the head of which is E. J. Philip, of the Steam Specialty Co., Toronto. This sale is the first of the contemplated sales of patents, the company having recognized the fact that in the grate bar business it was impossible to have the manufacturing done at any one centre for a large territory, and they decided to deal with local concerns for a specified territory. Although these grate bars have only been on the market for less than a year the sale has been unexpectedly large, and the syndicate now owning the rights for Ontario and Quebec have in E. J. Philip a man qualified to handle the territory to the best advantage.

J. C. Wilson & Co., Glenora, Ont., report business very active all the season. Recent shipments, independent of their export business have been large, and include the following orders for Little Giant Turbines: One 16-inch wheel to C. Becker, New Dundee, Ont.; Jas. Angell & Co., St. John's, Nfld., one 16-inch wheel; Pontbriand & Frere, Sorel, Que., one 21-inch turbine; Henderson & Potts, Halifax, N.S., one 12-inch wheel; Williamson & Crombie, Kingsbury, Que., one 24 inch turbine (this adds another to their list, making six wheels taken by them); W. Anngier, Haydon, Ont., one 16-inch wheel; Messrs. Snyder, Conestoga, Ont., one 33 inch wheel; G. C. Whyte, Galetta, Ont., one 24 inch wheel; H. J. Pidgeon, New Richmond, Que., one 10 inch turbine; John Dadson, Union, Ont., one 12 inch wheel; T. Lindott, Sparta, Ont., one 16 inch wheel.

The trustees of the American School of Correspondence, 156 Tremont street, Boston, Mass., have made a new departure in their plan of promoting students. Believing that a personal exposition of the advantages of a school is often better than, or at least a great help to printer's ink, they have announced in an advertisement elsewhere in this issue their willingness to grant a limited number of free scholarships to men in various large establishments and parts of the country. We are not advised as to the exact conditions, but any one who thinks he would like to have one is invited to correspond with them, giving his occupation, and his application will receive consideration by the trustees. The school calls attention to its courses in mechanical and electrial engineering (including a complete course in mechanical drawing), the former including steam, locomotive and marine engineering. Its work is exclusively devoted to these branches.

A typewriter of Canadian manufacture has been adopted by the Government of the Argentine Republic for special use in its postal and telegraph work, as appears from the following paragraph in a recent number of "La Nacion," published at Buenos Ayres: "The Postoffice Telegraph Department had a semi-private trial of typewriters yesterday afternoon. The machines on exhibition were the New Century, the Oliver, the Densmore and the Yost, all but the Oliver being submitted by the one firm, the latter machine having to stand the risk of accidents and mishaps against the other three. Two of the machines were fitted with an extraneous machine, and the forms used to receive the messages, and the messages themselves, were adapted to suit the requirements of this extraneous and additional machine, called the "Gorin Tabulator." The Yost and the New Century, with its tabulator had to give up almost at the beginning, and the young lady who had operated the latter before it broke down, sat beside and prepared the paper for Mr. Brown, who operated the Densmore. Still Ernest Ruggeroni, who manipulated the keys of the Oliver with lightning speed, took all the messages, as also did Mr. Brown with his Densmore, his Gorin Tabulator and his assistant. The director of the Telegraph Department, Senor Lopez, then requested both parties to take the messages on the ordinary telegraphic forms; but the Yost and the New Century and the Densmore, with their three operators and the two Gorin Tabulators, declined, and the Oliver found no competitor."

Electric Flashes.

The Jones & Moore Electric Co. are installing an electric lighting plant for the Atlantic Refining Co., Toronto.

The name of the Hamilton Motor Co., of Peterborough, Ont., Ltd., has been changed to the Colonial Motor Co., Ltd.

Stanley C. DeWitt, electric supplies, Sydney, C.B., has admitted A. W. MacKinlay a partner as DeWitt & MacKinlay.

The Empire Carpet Co., St. Catharines, Ont., have put in a new type incandescent dynamo from the Jones & Moore Electric Co.

A complete telephone system is being put in the factory of the R. & T. Watson Co., Toronto, by the Jones & Moore Electric Co.

The Williams Box Co. recently installed two electric motors in their new factory from the Jones & Moore Electric Company.

The Waterpower and Electric Co., Perth, Ont., recently increased its dynamo capacity by a 150-k.w., S.K.C., two-phase generator.

Rider & Kitchener, Lindsay, Ont., recently purchased a new 100 light incandescent dynamo from the Jones & Moore Electric Co.

The bylaw to raise $30,000 to establish a municipal electric plant has been passed by the town of Almonte by a majority of over 2 to 1.

The Bertram Engine Works, Toronto, are putting in two 500 light direct current lighting machines from the Canadian General Electric Co.

The village of Blyth has adopted electricity for lighting and is now putting in Canadian General Electric Co. machinery for a 1,000-light plant.

The City Dairy Co., Toronto, has put in a 75 k.w. Canadian General Electric power and lighting plant, direct connected to their engine.

James Spense, Colborne, Ont., whose plant was recently destroyed by fire, has just put in operation a 30-k.w., S.K.C., two phase generator.

R. Dunsmuir & Sons are putting into the Union Colliery, B.C., two Canadian General Electric Co.'s double-motor mining hoists of 50-h.p. each.

The Simpson Knitting Mills, Toronto, are now lighted electrically, a 500-light plant having been put in from the Canadian General Electric Co.'s works.

The Oxford Electric Light Co., Oxford, N.S., has ordered a 30-k.w., S.K.C., two-phase generator from the Royal Electric Co., for town lighting.

The Jacques Cartier Water Power Co., of Quebec, have recently placed orders with the Canadian General Electric Co. for several 5-h.p. and 10-h.p. induction motors.

The Paris, Ont., Electric Light Co. is replacing the plant recently burnt in the big fire by a new 1,000-light plant from the works of the Canadian General Electric Co.

The Labrador Pulp and Electric Co., Murray Bay., Que., have purchased a 150-k.w., S.K.C., threephase 4,400-volt generator and switchboard from the Royal Electric Co.

The Renfrew Electric Company is enlarging its plant by a 100-k.w. revolving field monocyclic generator and equipment complete, from the works of the Canadian General Electric Co.

The Royal Electric Co. are supplying the Cranbrook, B.C., Electric Light Co. with a complete plant to light the town, including a 35-k.w., S.K.C., two-phase generator and switchboard.

The Canadian Gold Fields Co., Ltd., Deloro, Ont., recently bought from the Royal Electric Co. a complete alternating current plant, including a 30-k.w., S.K.C., two-phase generator and switchboard.

The Oshawa Electric Light Co. is changing over its entire system from single-phase 1,000-volts to the S.K.C. two-phase 2,000-volt system, and have ordered a 100-k.w. generator from the Royal Electric Co.

The Jones & Moore Electric Co. report the following among recent motor sales: J. Dubois, Hull, Que.; J. M. Loose, Toronto; John Flynn, Quebec, Que.; York Machinery Co., and W. E. Massey, Toronto.

The Manhattan General Construction Co., of Newark, N.J., have appointed E. J. Philip, of the Steam Specialty Co., Toronto, to be general selling agent in Canada for their well known enclosed arc lamps.

Roderick J. Parke, consulting electrical engineer for Perth, has reported to the town his valuation of the arc lighting plant of the Perth Electric Light Co., which the corporation may take over as a municipal plant.

The Royal Electric Co. has supplied the Dominion Rock Drill and Foundry Co., of Napanee Mills, Ont., with a complete lighting plant for their foundry, including a multi-polar direct-connected generator.

The Royal Electric Co. recently installed an 800-h.p., S.K.C. synchronous motor, complete with switchboard for the compressor plant in the LeRoi Mine, to operate off the Kootenay Light & Power Co.'s lines.

The Lachine Rapids Hydraulic and Land Co. have had an increased demand recently for induction motors. They have placed orders with the Canadian General Electric Co. for these motors, aggregating 130-h.p.

The Hamilton Electric Light and Cataract Power Co., have purchased from the Canadian General Electric Co., a 200-k.w. special transformer, which transforms from 20,000 volts, three-phase, down to 2,400 volts, two-phase.

Owing to the increase of population of New Glasgow, N.S., the N. G. Electric Light Co. is increasing its plant to 2,000 lights, and are putting in six single phase alternators from the Canadian General Electric Co.'s works.

The T. Eaton Co., Toronto, have an order with the Manhattan General Construction Co., for a number of their enclosed arc lamps. This will make the number of lamps of this system used by that company between 300 and 400.

The Talismanic Belt Clinch, for which J. W. Bowden & Co., Toronto, are selling agents, is being used by the Colborne Electric Light Co., the Gananoque Light and Gas Co., the Peterborough Light and Power Co., and the Parry Sound Electric Light Co.

The Canadian General Electric Co. is putting in a 500 light plant for the village of Sunderland, Ont.

Southampton, Ont., is being equipped with a 2,000 light electric plant from the Canadian General Electric Co.

The Trail, B.C., smelter, owned by the C.P.R., is putting in a 200 h.p. C.G.E. induction motor for forced draft for the smelter.

A committee of the town council of Springhill, N.S., is preparing a report on the cost of a municipal lighting plant of 1,500 lights.

The Hamilton Electric Light and Power Co. have ordered six C.G.E. 1,000 h.p. two-motor car equipments for use on the consolidated railway lines at Hamilton.

Warden Evans, of Lincoln county, Ont., is promoting a company to build an electric road from Queenston to Niagara-on-the-Lake, and thence along the lake shore to Port Dalhousie, a distance of 20 miles.

Gen. Thayer, representing the Kitson and Hydro-Carbon lamps, has stated to the Toronto city council that if his company got the contract for lighting Toronto they would erect a factory and manufacture for the Canadian market in Toronto.

The St. Hyacinthe Gas and Electric Co. is putting in a new system of electric lighting. It is known as the constant current street lighting system, for the operation of which at the start, the Canadian General Electric Co. are supplying three 25-light alternators.

W. T. Pember, G. H. B. Hooper and W. D. Earngey, Toronto, Ont., have been incorporated as the Magnetic Electric Brake Co., Ltd., to manufacture, sell and deal in magnetic-electric brakes; capital, $500,000; head office, Toronto.

The Hamilton, Grimsby and Beamsville Electric Ry. Co. will apply to the Legislature for power to extend its line to St. Catharines, Niagara and Niagara-on-the-Lake, and to issue bonds not exceeding $10,000 per mile of the whole line.

The B.C. Railway Co., of Victoria, is putting in an electric transmission plant, operated from Goldstream, a distance of 12½ miles. A 500-k.w. generator is being furnished by the Canadian General Electric Co. for lighting, shop and power purposes.

The Carleton Place Herald says that town is to have a second electric light company, G. A. Burgess having organized a company and applied for incorporation. The water power at Arklan will be utilized, and electricity for power as well as for lighting will be furnished.

The Edwardsburg Starch Co., Cardinal, Ont., recently made a large purchase of electrical machinery from the Royal Electric Co. They bought two 50-k.w., S.K.C., two-phase induction alternators complete with switchboards, also two 20-h.p. and five 5-h.p. S.K.C. induction motors and complete incandescent and arc lighting plant for their starch works.

Sheik's Island dam, 10 miles above Cornwall, is to be used for large power works by which electric current will be conveyed to Cornwall, and used also for lighting the Cornwall canal. The power-house will provide for 4,000-h.p., but operations will commence on 1,000 h.p. M. P. Davis has the contract for the canal and buildings, and work was commenced last month.

The big Westinghouse electric generators at the power-house on the Canadian side of the Niagara river, were set in motion a few days ago. Their capacity of transmission is 30,000-h.p. All the principal heavy leather belts are of Canadian manufacture, and were supplied by Sadler and Haworth, of Montreal and Toronto. They are the largest of the kind in use in that part of the country. There are several 44 inches wide, some 24 inches wide and a number of smaller sizes, each about 100 feet long.

A considerable development of waterpower is taking place along the canal at Morrisburg, where about $100,000 is being spent in hydraulic and electrical works. The former are being supplied by the Wm. Hamilton Mfg. Co., of Peterboro, and the latter by the Canadian General Electric Co. The latter company are now installing a 200-k.w. revolving field three-phase generator with transformers, etc. It is expected that power and light will be supplied to the district early in the new year.

With regard to their recent installation of lighting plant the Benjamin Manufacturing Co., makers of carriage wheels, Yarker, Ont., write the Jones & Moore Electric Co., as follows: "We are pleased to say that your Mr. Dalton has finished the installation, and we have had the current on three times, and each time with most satisfactory results. The dynamo started off in fine shape, without requiring the slightest adjustment, and ran perfectly cool all night, and gave a beautiful light. We consider it a first-class job, both as regards the dynamo and the manner of installation. If you can use us as influence, at any time, we are at your disposal."

The Lakefield Portland Cement Co. to which reference was made last month, will have their works operated entirely by electricity. The water power is situated about 5 miles from the works to which electric current will be transmitted at a pressure of 10,000 volts by a 600-h.p. Can. Gen. Elec. generator, and transformed at a sub-station at the cement works. In the works 14 motors of various powers will be distributed to provide power for the different departments of manufacturing. The installation is now in progress. After the works are supplied it is the company's intention to furnish light for the village.

The Electrical Construction Company of London, Ont., Ltd., find their business so expanding that they are obliged to enlarge their premises and equip their factory with the latest improvements for the economical handling of their machinery. They have purchased lots No. 32, 34, 36, 38 and 40 Dundas street, west, opposite the Court House, 200 feet deep, on which they propose to erect a three story factory. This company have recently extended their business to include fixtures, house-wiring and general electric supply trade, together with several specialties of foreign manufacture. They will in their new factory be prepared to handle light and power generators of all sizes, and for all requirements. Their factory is being built according to the plans of the so-termed modern machine shop, having traveling crane covering the entire shop, and galleries on each side for the lighter work, the main floor being used for the heavy tools and handling of heavy work. They will thus be in a position to turn out very high grade machinery at a minimum of cost.

Marine News.

Graham, Horne & Co., Lindsay, Ont., will build two new tugs this winter to replace the present "Aikens" and "Mary Ann." They will be built of British Columbia fir.

The Dominion Dry Dock & Marine Construction Co., of Dartmouth, N.S., have had incorporation granted them under the laws of New Hampshire; capital stock, $500,000.

W. L. Lovitt, I. M. Lovitt and L. Chipman, Yarmouth, N.S., are applying for incorporation as the Brookside Shipping Co., Ltd.; head office, Yarmouth, N. S.; capital stock, $30,000.

The new steamer "Georgetown" was launched the other day at Buffalo, and is to be taken down the St. Lawrence to the sea as the first steamer built on the great lakes for ocean traffic.

The steamer "Turret Bell," which went ashore at Bryon Island, Magdalen Islands, in July last, has been repaired at Halifax at a cost of $50,000, and will now resume her trips at Sydney, C.B.

The wrecked steamer "Newfield," ashore at White's Cove, N.S., broke in two on Oct. 8th, and part of it sank in deep water. This means a great loss to the owner, Ed. Lantalum, St. John, N.B., who had purchased the boat at auction for $250, as all the machinery was in the portion of the vessel which sank.

American capitalists have purchased the plant of N. Evan & Son, iron and steel ship repairers and boiler makers at Halifax, N.S., and are about to construct a large dry dock and steel ship building plant. Over $1,000,000 will be spent on the works, which include large piers. Work of construction will begin at once.

McLeod and White, Welland, Ont., propose to build a new tug. It will have a triple expansion compound 22 x 24 engine, and its hull will be 70 feet long.

The Dominion Government is arranging for the building of a new steamer to take the place of the wrecked "Newfield." She will be adapted for light-house supply service, and will be fitted with cabling gear. It will be much larger than the "Newfield," and is expected to be ready for spring service.

The steamer "Garonne" has been purchased by Frank Waterhouse & Co., of Victoria, for $150,000. This steamer was formerly in the Australian passenger trade, but lately used as a transport. She will now be employed in British Columbia trade.

G. McL. Webster, Montreal, Que.; A. D. Webster, L. C. Webster, J. C. Kaine, W. A. Marsh, D. H. Geggie, J. H. Holt, G. O. Seifert, J. R. Ronald, Quebec, Que., have been incorporated as the St. Lawrence Steamship Co., Ltd., to build or run steamers; capital, $100,000.

The C.P.R. Co. have prepared plans for a new steamer, which will be built this winter to run on the route between the Nelson and Kootenay Landing in connection with the Crow's Nest Pass Railway. It is said the steamer will be superior to the "Rossland," which plies on the Arrow lakes between Arrowhead and Rossland.

H. H. Gildersleeve, manager of the Lake Ontario and Bay of Quinte Navigation Co., is having plans and specifications prepared for a new steamer to be built this winter at Kingston, Ont. He has also been inspecting the steamer "John Endicott," at Boston, with a view of purchasing it for the Bay of Quinte route next season.

The steamer "City of Parry Sound," owned by the Northern Navigation Co., was burned at Collingwood on October 9th. She was built in Meaford in 1888 by the late Hugh Chisholm, father of A. J. and W. N. Chisholm of Owen Sound, and was valued at $30,000. Insured for $15,000. Cause of fire unknown.

The steamer "Kaslo," of the K.R. and N. Co., was launched on October 1st, and will run from Kaslo to Kuskonook, connecting the Kaslo and Slocan railway with the Bedlington and Nelson. She is a stern wheel steamer of 170 feet stem to transome, with a beam of 26 feet 6 inches, and depth of hold 7 feet 6 inches. She will be the largest steamer on the Kootenay lake.

The handsome passenger steamer "Evangeline," which is the first of two vessels ordered by Sir Christopher Furness, has been launched on the Clyde, and will run on the Furness Line between London, Halifax and St. John, N.B. The vessel is 385 feet in length and 45 feet beam by 30 feet 6 inches depth, and will be in command of Capt. Williams, of the Furness Line.

T. B. Bowring, of the great London, Liverpool and New York shipping concern, has lately been visiting the Dominion Coal and Dominion Iron and Steel Companies' properties at Glace Bay, Louisburg and Sydney, and it is said, has engaged to construct three large modern steamers of 6,000 tons for the Cape Breton coal carrying trade. The names of the steamers are to be "Mira," "Mystic" and "Melville," the latter to be christened in honor of H. Melville Whitney.

Capt. Alex. McDougall, Collingwood, Ont., has received the contract for building a 3,000 ton passenger propeller for the Beatty Line. She is to be designed by the company's architects. The new craft will be of steel, built on the channel plan, her dimensions, 325 feet over all, 43 feet beam and 27 feet deep. Her triple expansion engine will develop 2,500 h.p., driving her fifteen miles an hour at ordinary speed, and about seventeen when pushed. Her cabins will extend from the pilot-house to the stern, and they will be handsomely furnished. Her route will be from Sarnia to Duluth, to Fort William, and back to Sarnia. Her cost will be between $350,000 and $400,000, and she will be finished by September next. She will have 75 staterooms and parlors, and accommodation for 225 passengers.

—P. W. St. George, city surveyor of Montreal, has resigned.

—Hon. Wm. Harty, who has bought the Kingston Locomotive Works for $75,000, states that he has orders from the Government for 20 locomotives for the I.C.R.

Personal.

T. H. Wiggins, C.E., of Cornwall, is carrying out extensive drainage works in Winchester and neighboring townships.

T. W. Gibson, secretary of the Ontario Bureau of Mines, has been promoted to be successor of Archibald Blue as director of the Bureau.

Thos. Skinner, of Mitchell, Ont., has received $1,000 damages for the loss of an arm in the Hardill Engine Co.'s works of that town.

The appointment of Newton J. Ker as city engineer of Ottawa, recommended by a committee of the Ottawa city council, has been confirmed.

Wm. Clare has been appointed engineer of the East-end disposal works, and C. Leckie, engineer of the Ferguson avenue works at Hamilton.

Mark B. Thomas has resigned the management of the St. Thomas Street Railway Company to take the management of the J. H. Still manufacturing company.

James C. Robertson, formerly of the Harris works, St. John, N.B., is now vice-president and general manager of the Standard Steel Car Wheel Co., at Springfield, Mass.

Prof. Prince, commissioner of fisheries, Ottawa, has recently visited the maritime provinces, and spent some time at the marine biological station at St. Andrews, N.B., studying marine life in all its phases.

W. Mahlon Davis, C.E., formerly of Aylmer, Ont., has been appointed consulting engineer in connection with the proposed waterworks and sewage system and sewage disposal plant at Sturgeon Falls, Ont.

A. Milne, C.E., town engineer of Aylmer, Ont., has resigned to accept the superintendency of the St. Catharines waterworks. Mr. Milne, of whom the Aylmer papers speak very highly, assumes his new duties this month.

W. F. Chapman, engineer at the Canada Carriage Co., Brockville, has been appointed chief engineer of the waterworks pumping department of that town. Mr. Chapman is an ex-president of the Canadian Association of Stationary Engineers.

Owing to ill-health, R. B. Angus has severed his connection with the Montreal Street Railway Co., of which he was president, and it is expected that he will retire from the directorate of the Dominion Iron and Steel Co., for the same reason.

T. F. Dryden, for the last seven years with the Royal Electric Co., has been appointed representative of the Westinghouse Electric and Manufacturing Co., Pittsburg, with headquarters at Toronto. Mr. Dryden is well known in the West, and is to be congratulated on securing such an important position.

Geo. W. Thompson has been appointed chief engineer of the T. Eaton Co.'s, Toronto, plant, in succession to E. J. Philip. Mr. Thompson has been in the employ of this firm for the past twelve years, and was assistant engineer to E. J. Philip for some time previous to that gentleman's resignation as chief engineer and mechanical superintendent.

L. Sapery, of the Syracuse Smelting Works, Montreal, has just returned from Europe. He has received some large orders in England as well as some in France, and he reports business to be in a very healthy condition. The foreign orders for this company's celebrated Babbitt metals and Columbia phosphor tin, etc., will, we understand, be filled through their Canadian works.

Louis J. Marien, C.E., superintendent of the Montreal water department, died last month of typhoid fever. Deceased was educated at the Polytechnic school, where he passed his examination with honors. He was appointed surveyor in the city road department in 1891, which post he filled till appointed superintendent of the waterworks last May. He was 42 years old, and leaves a wife and six children.

A. K. Kirkpatrick, C.E., has been appointed city engineer of Kingston at a salary of $1,500. After graduating from the Royal Military College in 1882 he was employed on construction work on the C.P.R., and was afterwards town engineer of Smith's Falls. Last year he went to Egypt as engineer in charge of the Egyptian Railway Administration, a syndicate virtually controlling the railways there. He returned to Canada early last month, when by the death of Mr. Folger he became engineer of the city in which he was born.

Wallace C. Johnson, C.E., who has but recently recovered from the severe illness which we noted last spring, has accepted an appointment as chief engineer of the Shawenegan Water and Power Co., and has opened his office as consulting engineer at No. 1724 Notre Dame street, Montreal. Mr. Johnson has been the chief engineer of the Niagara Falls Hydraulic Power and Manufacturing Co. at Niagara Falls, N.Y., for the past fifteen years, and has had entire charge of all the large work of power development which has been done by that company. He still retains a connection with that company as consulting engineer.

Mining Matters.

The old Cariboo Cove coal mines in Richmond county, C.B., which were in operation thirty years ago, are again being worked.

The Nova Scotia Steel Co. have acquired extensive manganese deposits on the Magdalen Islands, for the sum of $300,000.

The James Cooper Co., of Montreal, have recently shipped to the Mikado Gold Mining Co., Rat Portage, Ont., a hoist, which holds 3,000 feet of rope, and is the largest ever imported into that district.

A large deposit of coal has been discovered near Harbor au Bouch, C.B. The seam is located about fifty feet from the water's edge on the Nova Scotia side of the Strait of Canso. Hon. J. E. Corbett, M.L.C., is interested in the discovery, and if reports are favorable the Government will supply machines for prospecting purposes.

At a meeting of the shareholders of the Nickel Copper Company at Hamilton, Ont., on Oct. 1st, it was decided to accept the lease of the Hoepfner Refining Co.'s new buildings on the terms offered by the Refining Company. The nickel copper shareholders also assented to the issue of first mortgage bonds to the amount of $1,000,000. It is thought the works will be in operation this month.

The Mond Nickel Co., Victoria Mines, Ont., J. M. Clark, Toronto, attorney; the Bruce Copper Mines, Ltd., Bruce Mines, Ont., N. A. Abrahams, attorney, Bruce Mines, Ont., and the Rainy River Development Co., Ltd., Rat Portage, Ont., W. A. Weir, Rat Portage, Ont., attorney, have been licensed to carry on in the province of Ontario the business of mining, milling, reduction and development companies.

JAS. HUGGETT, PRESIDENT, C.A.S.E., TORONTO, NO. 1.

James Huggett was born at Chatham, England, and at the early age of 14 entered the Royal Navy dockyards at that place, working for seven years in the engineering departments. When 21 years of age he came to Canada, and has occupied many positions of responsibility. For 12 years he was with the A. S. Whitton Mnfg. Co., of Oshawa, leaving them ten years ago to become chief engineer of the Freehold Loan and Savings Co., Toronto, whose buildings are equipped with a modern system of heating and ventilating. He here fulfilled his duties so well that when the amalgamation of the Canada Permanent and the Western Canada Co.'s business with the Freehold took place he was appointed to take charge of the combination's various buildings and plants. For many years Mr. Huggett has been identified with the C.A.S.E., and at various times has held office. His work for the association has been so well appreciated that the presidency has now been bestowed upon him.

The first train over the new Great Northern Railway spanning the Ottawa at Grenville and Hawkesbury ran on the 24th of October.

COUNT ZEPPELIN'S AIR SHIP.

The day of aerial navigation has at length arrived. Count von Zeppelin, a retired German general, who has been devoting all his energies to the subject for years, and who has been assisted with money by Emperor William in a princely fashion (that monarch having given 4,000,000 mks. out of his private purse, besides help from the Government), has made an air ship, which can be steered, and make a speed of 18 to 21 miles an hour. This is sufficient to make headway against any ordinary wind, but not against a high gale. The first flight was made over Lake Constance, July 2nd last, but the steering gear got deranged, and the ship had to descend to the lake, which it did without difficulty. An improved steering gear was then made, and with this a completely successful flight was made October 17th, when the Count manœuvered the air ship in all directions. Gustav Levering and Eugen Wolf, two of Count Zeppelin's assistants, have given a brief account of the ship and its first flight, in Pearson's Magazine and McClure's Magazine from which our illustrations are taken.

The ship is a cigar-shaped contrivance, pointed at both ends, the frame work and most of the metal parts being of aluminum. The frame work consists of 24 aluminum hoops, strengthened and connected by rods and ribs, which divide the whole interior into 17 compartments, each of which contains a separate balloon, all of cylindrical shape except the two end pieces. The object of making the balloons into compartments is that if any one of them leaked or burst the others would maintain the ship in the air, or at least ease its descent. The balloons are composed of a special fabric called "ballonin," said to be a tightly woven cotton or ramie fiber. They contain gas without any appreciable loss for five weeks. Around these balloons is an outer frame work covered on the upper side with pegamoid (which is water proof), and on the lower side with silk. The air space between this outer and inner frame is about 2 feet, and is for the purpose of preventing expansion of the enclosed balloons by the heat of the sun. The total length is about 415 feet, the diameter about 38 feet, and the 17 compartments hold 14,780 cubic yards of gas. Each balloon has its own safety valve, and four have an extra outlet valve at the top, controlled from the cars. Underneath this great tube, and running from end to end, is a gallery, or suspended bridge, along which the crew may travel, and the weighting of which at one end or the other inclines the ship upward in the air or downward. In this bridge, midway between the centre and each end are two cars in which the ballasting and the engines are placed. The ballast consists of water enclosed in shallow pans of aluminum and can be discharged in a moment, though it is needless to say such a form of ballast could not be used at a great altitude or in a cold climate. Sand in this case would be an easy substitute. In ordinary circumstances the ship can be inclined upwards or downwards by a compensating weight, slid forward or backward along the bridge.

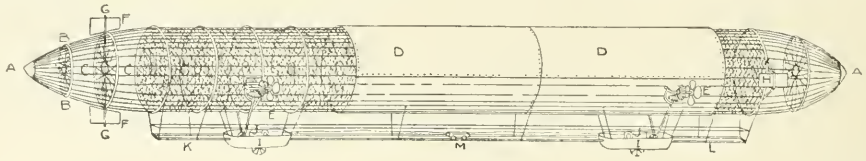
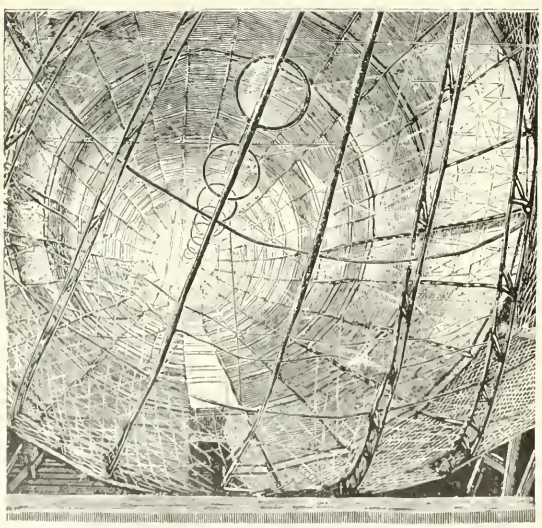


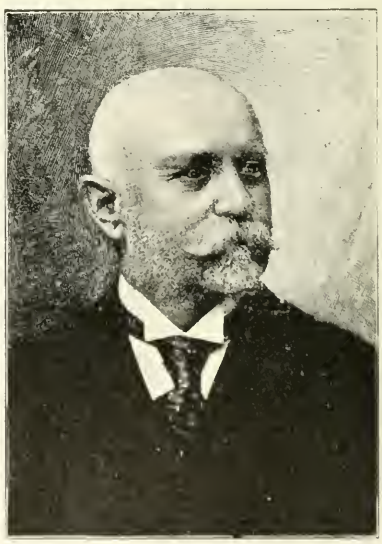
DIAGRAM OF THE AIR-SHIP.

A A Aluminum points; length from A to A, 415 feet.
B B A ring with spokes similar to those of a bicycle wheel.
C C Compartments or balloons.
D D Portion of the outer covering.
E E Propellers.
F F Foremost rudders, turning on axle G G.
H One of the rear rudders.
I I Gondolas of aluminum plates, rightly attached to the cigar.
J J Daimler Motors.
K Platform or gangway.
M Running compensation-weight, position of which is regulated from the front gondola.

In each car is a Daimler benzine engine, fed from an oil tank, having fuel for a ten-hours' run. Wolf says each engine has 16-h.p., with 700 revolutions per minute, and weighs only 715 lbs., or 44 lbs. for every horsepower, and that the two engines will attain a velocity of 26 feet per second, or say 17 miles per hour. The experimenters say that by lightening the ship in other parts it will be possible to add a third engine, which will increase the speed to 30 feet per second. Levering says the engines are 15-h.p., and capable of 1,200 revolutions per minute. Each engine operates a pair of propellers shaped like those of a steamer's, the blades being of aluminum, and the propellers being attached, one on each side, and presumably actuated by a bicycle chain gear. The propeller on one side revolves in the opposite direction to its mate. Each wheel is 3¾ feet in diameter, with four blades, and makes 1,200 revolutions per minute. Each engine controls a pair of rudders, one on the top of the big tube, and the other on the bottom.



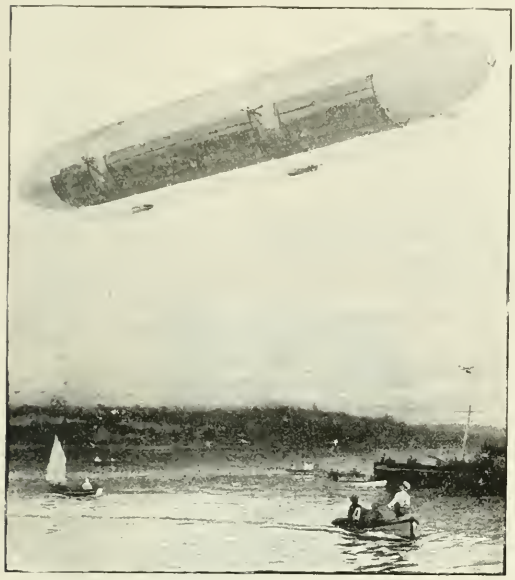
FRAME WORK OF AIR SHIP.



COUNT ZEPPELIN.

connected by a vertical shaft. Each rudder is a rectangular sheet of aluminum. One pair is fixed near the nose of the ship and the other at the rear, the dimensions of the latter being 6 2-3 by 15 feet. The forward pair, though apparently smaller have the most effect in steering, as they work through air that is being split up and compressed as the ship moves through the aerial ocean. The total weight of the ship, including crew, is about 20,000 lbs.

The cause of the accident on the first trip was that the rear steering gear got entangled with the stay rods, and as the



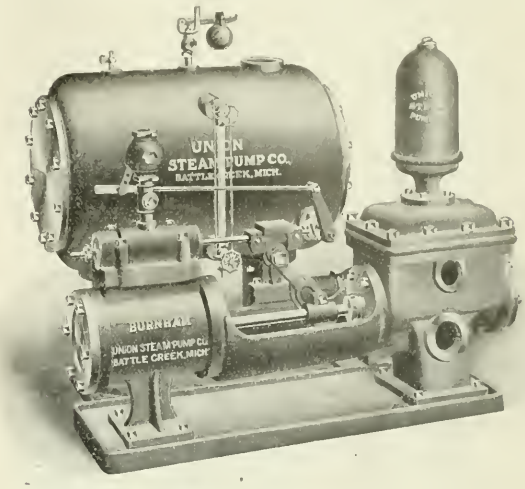
Air Ship over Lake Constance.

four rudders appear to be worked together a descent had to be made. When the mishap occurred the ship was 1,300 feet above the earth, but the air ship was made to settle gently on the lake without difficulty. It seems providential that just as Count Zeppelin feels the need, in some parts of his ship, of a metal which while being as light as aluminum has the qualities of steel, a new compound metal has been put on the market in Germany which exactly fills the want. This metal, which is called magnalium, is opportunely described in another part of this paper.

BURNHAM AUTOMATIC FEED PUMP AND RECEIVER

The accompanying cut is taken from a photograph of the Burnham Pump and Receiver, which is different in construction to anything in the market. The operation of the Burnham pump and receiver is entirely automatic, and may be briefly described as follows: The steam supply to the pump is controlled by a valve on steam pipe, which is connected by a lever to a float in the receiver. As the water of condensation collects in the receiver, the float rises, and opens the steam valve on the pump, the latter at once returns the hot water to the boiler, and in this way the entire water of condensation is returned automatically to the boiler as fast as it accumulates in the receiver with little loss of heat. As the water level is reduced in the receiver, the float falls and lessens the speed of the pump, until it finally stops as the water in the receiver reaches its lowest level. As will be seen from this description, the pump at all times supplies to the boiler the water entering the receiver, with little loss of heat, and only uses steam as required. The float in the receiver cannot possibly fill with water from any cause, as it is drained from the bottom through a hollow arm, which is in communication with the outside atmosphere.

The connection and fittings shown in the cut, consisting of suction and steam pipes from pump to receiver, gauge glass, drain cock, safety valve and chronometer governing valve, are furnished with the machine. This apparatus is not confined to the draining of condensed water from steam coils, as it may be equally well applied to any circulating system requiring automatic control by a pump. Darling Bros., Montreal, who are the manufacturers of this pump in Canada, have installed a large



number of the Burnham Automatic Pumps and Receivers throughout the Dominion, and state that they have yet to hear of a complaint from any of the firms using them. They are made in nine sizes, and particulars of these machines can be sent to any reader interested.

NEW CATALOGUES.

The Cataract Tool & Optical Co., Buffalo, N.Y., have issued a neat office hanger, showing a Cataract Precision lathe with grinding attachment, also a neat booklet on Cylindrical vs. Conical Bearings.

McOuat & McRae, founders and machinists, Lachute, Que., have issued illustrated circulars of their specialties in machinery for pulp and paper mills, saw and grist mills, and for butter and cheese factories.

C. L. Berger & Sons, 9 Province Court, Boston, makers of surveying, engineering and astronomical instruments, have issued an illustrated circular giving reasons why their instruments are the best, and giving a partial list of recent purchasers.

John Brown & Co., Ltd., Sheffield, Eng., send us a catalogue of their systems of induced draught. In addition to 42 pages of descriptive matter, embracing a number of useful tables, it has 18 folding plates of diagrams showing engines, furnaces and forced draught equipment largely for marine purposes, but also for stationary work. The catalogue contains a good many useful hints for the engineer.

The American School of Correspondence, 156 Tremont street, Boston, have issued a calendar of engineering studies taught by mail, explaining the terms and various branches taught. This institution offers a free scholarship referred to elsewhere.

The International Correspondence Schools, Scranton, Pa., have issued a calendar of a new branch of their educational work, namely, studies in grammar, correspondence, spelling, arithmetic, geography and United States history and civic government.

The Browning Engineering Co., of Cleveland, O., have issued their bulletin No. 500, describing a new steam dock capstan. The mechanism is illustrated and described in detail, and the makers explain that they make the same capstan with an electric driving mechanism.

The Abbott-Mitchell Iron and Steel Co., Belleville, Ont., have issued a handsomely designed description of their new works to which reference was made in last issue. The embossed cover has a fine view of the works, and there are several illustrations of the different departments.

Darling Bros., engineers, Montreal, have issued a very well printed and illustrated catalogue, describing their freight and passenger elevators. The preface states that their elevator business has now extended to all parts of the Dominion, and they have a plant specially devoted to this work that is without a superior in Canada. They build hydraulic, electric and steel screw hanging machines, for freight or passengers, also hand and sidewalk lifts.

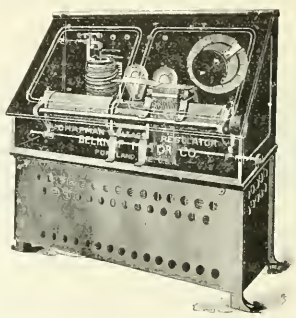
The B. F. Sturtevant Co., manufacturers of blowers, exhaust fans and ventilating and heating appliances, Boston, have issued a new edition of their illustrated catalogue of steel plate planing mill exhausters. Besides a description of appliances used for exhaust purposes in planing mills, it gives several pages of tables relating to the volume and pressure of air in forced draught, the pressure of water in columns, horsepower lost by friction of air in pipes 100 feet long, areas of circles, etc.

The Fairbanks Company, of Montreal, have just issued their new supply catalogue. It is a large and handsomely bound volume of a thousand pages, containing nearly two thousand cuts and photo engravings, showing the varied stock this well-known house carries. Commencing with the "Fairbanks' Standard Scales," the platform, baggage, and railway scales are shown with excellent cuts, which give a most comprehensive idea of the most intricate weighing machines. Then follows a catalogue of the Fairbanks' asbestos disc valves, and asbestos packed cocks, also complete pipe lists, and pipe fittings, and a large and varied line of pipe tools, all illustrated in the most complete manner; and after this a large assortment of steam specialties, such as the Foster pressure regulating valves, in which they are doing an increasing trade, They are also showing a complete list of their pipe threading machines, emery wheel grinders, and emery wheels, with prices. The drill and reamer department seems particularly complete, and is illustrated with the same attention to detail, which is a characteristic of the entire catalogue. Trucks, mining barrows, and an almost innumerable list of other items are given; and as it contains a large amount of information everyone in the hardware, plumbers' and steam fitters' lines will be glad to examine it for themselves. A photographic reproduction on a smaller scale is being prepared for general distribution.

CHAPMAN VOLTAGE REGULATOR.

The large Armour power plant recently erected in the United States includes in its switchboard equipment three Chapman voltage regulators for controlling the alternating current e.m.f. The illustration shows one of these machines in a case; in the Armour plant they were mounted directly on the switchboard. Each regulator consists of three essential parts, a resistance to be inserted or removed from the field circuit of the generator to be regulated, a working solenoid to do the work of inserting and removing the resistance step by step from the circuit, and an auxiliary relay solenoid to determine the movement of the working solenoid. The resistance is made of German silver coils, units of the enamel resistance type, or carbon. Ample carrying capacity is provided so the resistance will not heat to any extent. This resistance is connected to a series of copper segments placed in a horizontal row, and having a contact slider arranged to move over their surface. The contact slider is operated mechanically by the moving core of the working solenoid. The working solenoid consists of two differentially wound coils placed on a brass tube, one at each end of the tube; the middle portion of the tube is left vacant. Inside of the tube is fitted an iron plunger somewhat shorter than the distance through the two coils. At the centre of the plunger a rod is attached which passes out through a longitudinal slot cut in the vacant portion of the tube. The contact slider is attached to this rod and so moves with it and the plunger. In order to prevent too quick a movement of the plunger a very simple retarding device is used. The iron plunger is hollow and the rod in its centre has a valve which can be adjusted by turning a knob on the end to which the contact slider is fastened. The brass tube is closed at its ends and completely filled with oil. The movements of the plunger toward either end can take place only as it displaces the oil and causes it to move through the hollow plunger. The rapidity of the movement can be very finely adjusted by means of the valve. The force tending to move the iron plunger depends on the balancing of oppositely-wound coils against each other, and the balancing is determined by the action of the small auxiliary solenoid, whose only work is to cause one or another of two platinum pointed screws to make contact with the brass lever supporting its core. Contact with one screw causes perfect neutralization of the differential coil at one end of the working solenoid and so disturbs the balance and causes the plunger to move toward the other coil. And contact with the other screw causes neutralization of the coil at the other end and a movement in the opposite direction.

The small solenoid may be wound to suit the demands of station regulation. It may have simply a fine winding to be connected as a shunt across the lines to be regulated, and in this case it will secure constant-potential regulation at the point of attachment to the line. Or it may be wound with a fine winding as before and also with a coarse winding, the fine winding connected as a shunt to the line and the coarse one in series with the line. In this case it will regulate for constant potential at some distant point on the line which may be predetermined by the setting of an adjustable compounding switch provided as a part of the regulator. Or, again, the small solenoid may be wound with a single coarse wire in



series with the load, in which case it will secure regulation for constant current on the line. But whatever the nature of the regulation, the small solenoid will perform its duties with an accuracy as close as 1 per cent. above or below the normal, and is adapted to either direct or alternating-current circuits. Alternating currents are especially capable of close regulation by this instrument, as the slight jar incident to its flow through the small solenoid almost entirely eliminates the element of friction at the pivot of the lever supporting the core, and it will easily recognize a change of ½-volt on a 110-volt circuit. We understand that Munderloh & Co., wholesale electrical supply dealers of Montreal, are exclusive agents for this Chapman Voltage Regulator, and no doubt will be glad to receive enquiries from anyone needing them.

MR. HAYS AND THE GRAND TRUNK.

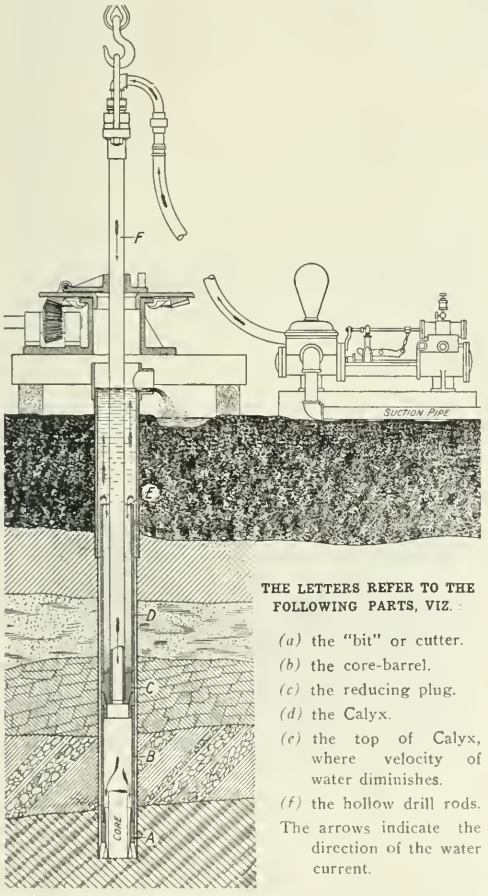
When Charles M. Hays was appointed general manager of the Grand Trunk at the beginning of 1896 this journal predicted a new era for that railway, and this prediction has been amply verified in the five years of his regime. He has brought order out of chaos in the internal management of the G.T.R., his energy has communicated itself to all departments, and he has left it not only the name "System," but all that the word implies in his reorganization of this vast aggregation of railways. His departure to take the presidency of the Southern Pacific Railroad will be a distinct loss to Canada, and we only trust his successor will be a man big enough for his shoes. No decision will be reached in this matter till the arrival of the president from England this month.

J. Caldwell, G. E. Willits, F. P. Rowe, Jas. Hunter, J. T. Crawford, W. G. Towle and W. H. Buchan, have been incorporated as the Wiarton Oil and Gas Company, Ltd., with a total capital of $20,000; head office at Wiarton, Ont.

THE CALYX DRILL.

BY C. M. MORSE, OF BUFFALO ENGINEERING CO.

Preliminary to the construction of power-plant by the Canadian Niagara Power Co., at Niagara Falls, that company did some prospecting to determine the character of material to be excavated in the construction of the wheel-pit and tunnel, which will be located in the Queen Victoria Park at Niagara Falls, Ont. The Power Company contracted with the Buffalo Engineering Company to furnish records by the use of a core drill, and the contractors have been able to furnish complete cores, of a minimum diameter of 3-inches, showing accurately the formation and location of different strata of rock. This work is done by the use of the "Davis Calyx Drill," which is a new apparatus for deep core drilling. Until quite recently, prospecting for minerals below the surface rock has been done almost entirely by the use of a diamond drill. The diamonds or carbons used for this purpose, which cost in the early days of the diamond drill about $5 per karat, are now sold for from $36 to $42 per karat. To meet this advance the makers and users of diamond drills have been compelled to resort to small holes and small cores, until now it is claimed that the cores that are practical on the score of cost, are so small in diameter that, unless the rock be very hard and homogeneous, the cores fray away, leaving the records incomplete.



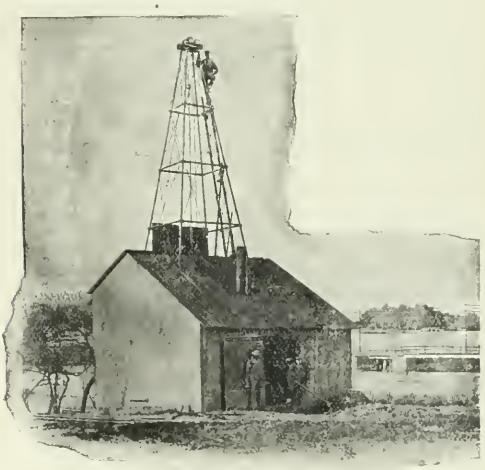
THE LETTERS REFER TO THE FOLLOWING PARTS, VIZ.:

- *(a)* the "bit" or cutter.
- *(b)* the core-barrel.
- *(c)* the reducing plug.
- *(d)* the Calyx.
- *(e)* the top of Calyx, where velocity of water diminishes.
- *(f)* the hollow drill rods.

The arrows indicate the direction of the water current.

The "Davis" drill seems to have solved the problem of obtaining rock cores of a useful size, as well as some other problems, the most important being the securing of all the chippings made in cutting the core out. These chips are all caught and deposited in a cup, or, as named by the inventor, a calyx at the top of the core barrel. The chippings being deposited in this calyx in regular sequence as they come from the borehole can be accurately located as to their origin. The cutter itself is of steel. The teeth being made of peculiar shape, their action, produced by rotating the drill rod slowly while a very heavy pressure is brough to bear upon the teeth, is similar to that of a mason's chisel. This action of the drill being in the nature of chipping rather than grinding, accounts for the long life of the teeth in operation. The tools are, however, quickly sharpened by those expert in handling the rig. These steel cutters will cut very hard rock, but when it is necessary to go through very hard materials, such as some layers of flint encountered in the work at Niagara Falls, the "Davis" cutter is removed and recourse is had to a diamond bit. This drill is peculiarly adapted to the interchange of cutters but, except in cases of very hard material, the "Davis" cutter seems to have a great advantage in the matter of speed of cutting, and extreme low cost as compared to the diamond cutter.

In the operation of the "Davis" drill various simple devices are used to make the work easy. The drill rods are quickly hoisted up and unscrewed; the core is uprooted; the core-barrel and the calyx hoisted and emptied in remarkably quick time. The great length of core-barrel insures a straight and accurate hole in the rock. The construction of the tubular steel derrick is unique, it being put together in sections which are connected by means of patented joints and universal folding turnbuckles that make it probably the quickest and easiest derrick to erect or knockdown that is on the market.



The drill in use at Niagara Falls is the first of the "Davis" drills to be used in Canada. The American company manufacturing these drills, put on the market their first rig only last July, but there are several now in use in the United States, especially in Pennsylvania, in West Virginia and Missouri. Probably the drill rig used by Mr. Edison in prospecting in connection with his big cement works at Stewartville, N.J., has done as much as anything to advertise the "Davis Calyx Drill." These drills seem to be adapted to a great variety of work. They will handle almost any kind of ground. They will either do core drilling, or go into the alluvial, or placer gold mining localities, and bring up even the finest particles of gold dust. The English company controlling the "Davis" patents, the Calyx Drill and Boring Co., Ltd., is doing a large business in China, Japan and the Malay Archipelago, besides in Great Britain and on the continent. In Russia, near the banks of the Caspian Sea, the "Davis" machines are drilling holes 19-inches in diameter and producing 18-inch cores. It is rather interesting to remark that this drill originated in Australia where, probably more than in any other country, the use of deep drilling has been incidental to the development of valuable resources, both in the locating of minerals and in the obtaining of artesian water supply. Mr. F. Harley Davis, the inventor of the drill, is an Australian driller of large experience, and his drill has been adopted for use by the Government of the Colony of Victoria. This great mining colony appropriates annually large sums for prospecting their mineral resources. In the year 1894, the sum set apart for this purpose was

£31,000, of which about £23,000 were spent in doing some 50,000 feet of drilling. In 1895, the Victoria Government bought five "Davis" drills, which, it is claimed, enabled them to do drilling for about one-half the cost of operating the diamond drills.

THE FLOATING OF THE "SCOTTISH KING."

Editor CANADIAN ENGINEER :

Sir,—My attention is called to a particular feature in the salvage of wreckage on our Canadian coasts, by a rehearsal at page 197 of the September number of The Scientific American of how the steamship "Oregon"—wrecked by grounding on a sunken rock in the Gulf of Petcheli on the confines of China—was raised and brought to dock for repairs. One of two of the engravings explanatory of the article purports to be a "view from port and underneath, showing injury to vessel's bottom, July 25th, 1900, with a copy of recital by telegram from Yure, of August 29th, of a full detail of the injury done to the ship's sheeting and frame-work," while the second engraving purports to be a view of "temporary patches put on by diver over injuries between frames 19 and 24."

Such has been to date one of the ordinary modes of raising sunken vessels, to wit: the patching of them by canvas and otherwise, or by sails drawn under them and attached by ropes running around and under the hull of the vessel and hauled in taut on deck. The vessel was then pumped of its water or of so much of it as would allow it to become buoyant, thus enabling it to hold its own until towed into port, and docked for repairs.

Now, sir, a steamer called the "Scottish King," was wrecked September, 1898, on the coast of Newfoundland, and so irretrievably damaged that all ordinary modes of patching, pumping and the like had failed to do the needful; when, after the vessel had been there for 19 months, and finally given up and abandoned as a total wreck, Messrs McArthur, of Montreal, proprietors of the vessel, on recommendation of Wm. Leslie of the Collins' Bay Rafting Co., applied to Capt. E. Bernier—the same man who has been before the public for some three years past as a would-be discoverer of the North Pole, and whose fertility of expedient in this the salvage of the "Scottish King," is an additional evidence of his fitness for such an undertaking.

Capt. Bernier, nothing daunted by the failure of all those who had tried their hand at the sunken vessel, and though it lay stranded in 23 feet of water, and as already stated had after 10 months of unavailing efforts been left to the mercy of the inclement coast it shoaled on, took her in hand, cemented down the lower deck air tight over the hull and stayed it, and instead of attempting to patch her and pump her out, he pumped air into her beneath the sealed or air tight deck, of which of course all the hatchways had also been secured and sealed with cement and asphalt, and thus forced the water out of her, and without any attempt at patching or stopping up the holes in her bottom, brought her safe to Quebec, docked her there, repaired her, within a couple of weeks, left with her on the 20th inst. for New Liverpool, where he took in a cargo of deals, and proceeded to Montreal where the vessel is at this writing completing her cargo, wherewith to sail for London about the middle of October, there to be sold by public auction for any profit to be thereby derived by proprietors and underwriters; as when a vessel has been wrecked and recouped and sold it is usual to give her a new name unsuggestive of the mishap.

The "Scottish King" is 364 feet in length, and of some 3,200 tons burden, and it is eminently suggestive to the trade to be thus made aware of how, in the future, stranded or wrecked vessels may be saved when there is enough of the hull remaining below deck to confine the compressed air necessary to keep them sufficiently free of water to make them buoyant, and at so cheap a rate; this vessel having cost some $240,000 in its construction, while its total salvage and repairs do not exceed $40,000, or more than 1/6 or 16 1-3 per cent. of its first cost, to start it again as new.

Quebec Oct. 1st.

The Parkhill Ont. Basket Co., Ltd., is increasing its capital stock from $5,000 to $20,000.

IMPERIAL TRADE NOTES.

The following were among the enquiries relating to Canadian trade recently received at the High Commissioner's Office in London, Eng. Addresses of the firms referred to can be furnished at this office: A Glasgow merchant and manufacturer's agent is open to represent a Canadian wood-pulp factory. A Scotch firm manufacturing stable fittings, man-hole covers, gully traps, gratings, etc., desire to have agents in Canada to take up their class of work. An importer of considerable quantities of maple manufactured into floor boards and blocks, asks for names of Canadian shippers of these goods. A Canadian firm of wagon and carriage makers would be glad to quote prices for wagons, which they are prepared to export to the United Kingdom.

The Keizer Brick Machine and Mnfg. Co., Winnipeg, are applying for incorporation.

Last year the corporation of the town of Levis, Province of Quebec, advertised for competition plans to be submitted by civil engineers for the best system of waterworks and sewerage for the town of Levis. Recently the judgment has been given in an elaborate report, which indicates a careful study of the different plans submitted. The judges were, Charles Baillairge, C.E.; Chas. E. Gauvin, C.E., Quebec, and Charles Baillairge, C.E.; Chas. E. Gauvin, C.E., and Jeremiah Gallagher, C.E., director of waterworks, all of Quebec, who Ottawa, and the second prize of $500 to Berlingnet and Lemay, have awarded the first prize of $1,000 to Robert Surtees, C.E., civil engineers, Quebec.

QUALIFIED ENGINEER holding first-class Ontario Association Certificate desires position to take charge of either steam or electrical plant or combination of both. Address **C.A.S.E.** c/o Canadian Engineer.

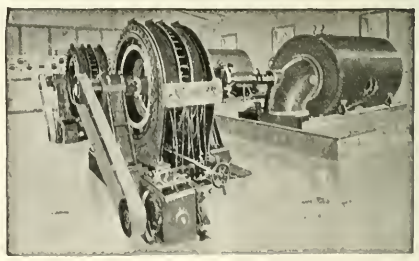
A COMPETENT BOOK-KEEPER wishes situation as accountant, or for general electrical work. Address, **R.H.,** c/o Canadian Engineer.

Mechanical Engineer

For head of draughting office in a factory, building stationary and marine engines boilers, saw-mill, pulp and general machinery; four hundred employees. A graduate of technical school with at least ten years' experience. This is a good opening for a bright, thoroughly up-to-date man. Address M.E., care of Canadian Engineer, Toronto. 10-3

Canada's Engraving House

You get Engravings Equal to the Best made in the World.



The Largest Users

of Engravings in Canada use Engravings made by us. They use ours now because they have used the others. Write us about your next Catalogue, Booklet and Advertisements.

MOORE & ALEXANDER,

Canadian Photo-Engraving Bureau

16 Adelaide Street West, Toronto

Half-Tone Engraving, Zinc Etching, Designing, Wood Engraving.

The Canadian Engineer

VOL. VIII.—No. 8. TORONTO AND MONTREAL, DECEMBER, 1900. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers.

E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

SEE PAGE 158 FOR CONTENTS.

WIRELESS TELEGRAPHY.

Professor J. A. Fleming, of the University of London, in a letter to the Times, tells of some remarkable achievements by Mr. Marconi, in wireless telegraphy. As is well known, an elevated conductor, generally a wire suspended from a mast, had to be used in transmitting a message through the air by the electric wave system. It was objected that messages could be read by other receivers than the one intended to get it, and thus the privacy of the communication would be destroyed. No one felt the force of this objection more strongly than the inventor himself. For the last two years he has not ceased to grapple with the problem of isolating the lines of communication, and success has now rewarded him, as he has modified his receiving and transmitting appliances so that they will only respond to each other, when properly tuned to sympathy. Other inventors have claimed to be able to do the same thing, but have not given practical proof of the solution of the problem. These experiments have been conducted between two stations thirty miles apart, one near Poole, in Dorset, and the other near St. Catherine's, in the Isle of Wight. At the present moment there are established at these places Mr. Marconi's latest appliances, so adjusted that each receiver at one station responds only to its corresponding transmitter at the other. During a three days' visit to Poole, Marconi invited Prof. Fleming to apply any test to satisfy himself of the complete independence of the circuits, and the following are two out of many such tests; two operators at St. Catherine's were instructed to send simultaneously two different wireless messages to Poole, and without delay or mistake the two were correctly recorded and printed down at the same time in Morse signals on the tapes of the two corresponding receivers at Poole. In this first demonstration each receiver was connected to its own independent aerial wire hung from the same mast. But greater wonders followed. Marconi placed the receivers at Poole one on the top of the other and connected them both to the same wire, about 40 feet in length, attached to a mast. Prof. Fleming then asked to have two messages sent at the same moment by the operators at St. Catherine's—one in English and the other in French. Without failure, each receiver at Poole rolled out its paper tape, the message in English perfect on one and that in French on the other. When it is realized that these visible dots and dashes are the results of trains of intermingled electric waves rushing with the speed of light across the intervening thirty miles, caught on one and the same short aerial wire and disentangled and sorted out automatically by the two machines into intelligible messages in different languages, the achievement seems wonderful. During the same demonstrations Marconi received messages from a transmitter thirty miles away, and recorded by an instrument in a closed room merely by the aid of a zinc cylinder, 4 feet high, placed on a chair. More surprising it is to learn that, whilst these experiments have been proceeding between Poole and St. Catherine's others have been taking place for the Admiralty between Portsmouth and Portland, these lines of communication intersecting each other; yet so perfect is the independence that nothing done on one circuit now affects the other, unless desired. A corollary of these latest improvements is that the necessity for very high masts is abolished. Marconi now has communication between Poole and St. Catharine's, thirty miles, by means of a pair of metal cylinders elevated 25 or 30 feet above the ground at each place.

One need not enlarge on the importance of this system for naval and military, as well as commercial, purposes, and it will stand as perhaps the most striking of the many advances in applied science that marks the closing year of the century.

THE MINER'S INCH.

A series of 235 observations were recently made in the hydraulic laboratory of McGill University, with a view to a determination of "the miner's inch," and the results of these observations were laid before the Canadian Society of Civil Engineers last month in a paper by Thomas Drummond, B.A.Sc. The records will be very useful in the mining regions of Canada, as furnishing data for delivering water at mines. The "miner's inch" of water, it may be explained, is an arbitrary measure adopted for selling water in mining districts, and is defined as the amount of water discharged by an orifice 1 inch square (or the equivalent fraction of a larger orifice), with a head of from 6 to 9 inches. The variation in the head makes the definition rather vague. In British Columbia it is defined as being 1.68 cubic feet of water per minute, or that quantity of water

which will pass through an orifice ½ an inch wide, 2 inches high, and 2 inches thick, with a constant head of 7 inches above the top of the orifice, and every additional inch shall mean so much as will pass through the said orifice extended horizontally ½ an inch. Mr. Drummond points out that as a definition, this is completely wrong. In the first place, widening the orifice changes the coefficient of discharge, and therefore the discharge itself. In the second place, this orifice actually discharges 2.147 cubic feet of water per minute, instead of 1.68 cubic feet, and this brings out a curious point, that certain shaped orifices with a thickness of 2 inches run full like a short tube, the vein is not contracted, and they actually give a greater discharge than they are supposed to give. The shape of the orifice has a perceptible effect upon the discharge. Circular orifices give the least discharge, rectangular orifices the greatest, and square orifices are intermediate. As the rectangular orifices becomes thinner, the width being the same, it will discharge proportionately more water. A 1 x 2-inch orifice, 2 inches thick, is just on the margin between flow with contraction and full bore. If fixed in the vertical position, with longest diameter vertical, the vein contracts. If fixed in the horizontal position, with the longest diameter horizontal, it will also contract, but if rubbed with the fingers on the edge, it will run full for a time and then contract again. If kept running full in this way, it will discharge about 1 cubic foot of water per minute more than when full contraction takes place.

Mr. Drummond's measurements lead him to the following conclusions: "There are difficulties in the way of delivering absolutely exact quantities of water, and these quantities cannot be measured out as a pound of tea is weighed over the counter. The definition of the module or unit, however, should be correct within a reasonable limit of error. If it is a definition of a single miner's inch from an orifice of one square inch, it should go no farther. If the inch is defined as being some practical part of the discharge from a larger orifice, it should go no farther than the capacity of that orifice, and as it is an unknown quantity to the outside world, the discharge should be given in cubic feet per minute. Convenient discharges are 1½ and 2 cubic feet. The flow under low heads is irregular. Heads of 1 ft. or more are not convenient because the water is delivered from ditches or flumes where the depth of water is never great. The question thus resolves itself into a choice of a standard module or unit from a flow under two conditions; (1) With a low head of 6¼ inches above the centre of the orifice, giving a discharge of 1½ cubic feet per minute, with the advantage that it is already partially recognized as the miner's inch, and with the disadvantage that the flow is irregular. (2)With a head of 11½ inches above the centre of the orifice, and a discharge of 2 cubic feet per minute, the flow being much more regular, but the quantity discharged new to the people. Definitions of both inches are given, but the author favors the last.

Definition No. 1 of the Miner's Inch.—The water taken into a ditch or sluice shall be measured at the ditch or sluice head. It shall be taken from the main ditch, flume or canal, through a box or reservoir arranged at the side. The orifice shall be fixed vertically at right angles to the delivering water way, and the edges and corners shall be sharp. The vein shall be fully contracted. The distance between the sides and bottom of the orifice and the sides and bottom of the water-way shall be at least three times the least dimension of the orifice. The orifice shall discharge freely into air.

One miner's inch of water shall mean ¼ of the quantity which will discharge through an orifice two (2) inches wide, and two (2) inches thick, made in a two-inch plank, planed and made smooth. The water shall have a constant head of 7¼ inches above the centre of the orifice. It shall mean a discharge of 1½ cubic feet per minute.

In definition No. 2, the first part is precisely the same, the latter part is changed as follows:

One miner's inch of water shall mean one-quarter of the quantity which will discharge through an orifice two inches wide, and two inches thick, made in a two-inch plank, planed and made smooth. The water shall have a constant head of 11½ inches above the centre of the orifice. It shall mean a discharge of 2 cubic feet per minute. A one-inch orifice may run full, but no experiments were made on this point. These discharges are from a standard brass orifice and are actually .478 and 1.997 cubic feet per minute. The discharge through a wooden orifice 2 inches thick is slightly greater than for a standard orifice, so that these discharges should be almost exactly 1½ and 2 cubic feet per minute. No attempt was made to reduce the observations to a common temperature. The temperatures for the brass orifice varied between 31.7 degrees and 46.5 degrees F., a range of 9.5 degrees F., with an average temperature of 48 degrees F. The temperature for the wooden orifices varied between 45 and 50 degrees F., with an average of 48 degrees F. The mean temperature for the whole was 45 degrees F.

—The system invented by Dr. Hans Goldschmidt for obtaining high temperature in metals by other means than the electric arc, and which is now being experimented on at Essen, Germany, is of much interest to engineers. This system, which is not altogether new, is based upon the heat of combination given off when aluminum is ignited in contact with certain metallic oxides. R. A. Hadfield, in 1895, succeeded in producing extremely pure iron by reducing ferrous oxide with aluminum. Dr. Goldschmidt's experiments were made with the object of discovering a mode of controlling the violent reaction obtained by the heating of aluminum in contact with metallic oxides, and these brought to light the important fact that it was not necessary to heat the whole mass up to the requisite temperature for ignition, but that it sufficed to start ignition at any one time. When combustion once started, the reaction proceeded steadily with more or less speed throughout the whole mass, thus generating within itself the whole of the heat required. In the case of the refractory oxides, it would have been a difficult matter to apply the requisite heat for ignition at any point had not Dr. Goldschmidt made the still more important discovery that, although certain oxides combined with aluminum at so low a temperature that they could be ignited with an ordinary match, yet they, nevertheless, in their combustion, developed so much heat that if a small quantity of these oxides was placed

upon a mixture of refractory oxide and aluminum and ignited, a reaction was started in the same, which then proceeded automatically, as before. The heat developed by the combustion of a mixture of alumina and iron is sufficient to start the reaction between the aluminum and iron oxide mixture, and as this proceeds, more and more of the same is added until within a minute or two there is a crucible containing reduced iron covered by a thick coating of alumina slag. On pouring off the slag the temperature of the underlying liquid iron can be tried by pouring it on to a mild-steel plate or along the side of a mild-steel bar, when the hot iron cuts its way through with ease. Pyrometer experiments have established the temperature reached in the operation at between 2,900 deg. C., and 3,000 deg. C., that is to say, 1,000 deg. C. more than that reached during the hottest period of the Bessemer blow. In the case of the reduction of chrome from its oxide by this method, the temperature of 3,000 deg. C. is certainly reached—a temperature hitherto obtainable by the electric arc alone. A method of welding together iron bars or rails has also been worked out by this, in which the heat for the weld was obtained from the combustion of aluminum and iron oxide. It is estimated by Dr. Goldschmidt that it is commercially economical to connect in this way the rails of a street railway system, and he maintains that the cost of maintenance will be considerably less with joints made in this way. It would, of course, considerably increase the conductivity at the joints, and perhaps do away with the bonding which is now absolutely necessary.

—Professor Trowbridge, director of the physical laboratory of Harvard University, has been discussing the possibility of finding a cheaper substitute for copper. Aluminum is naturally pointed to, and its decline from $90 a pound, in 1859, to 65 cents a pound in the present year, for castings, enables it to compete with other metals as to price. Aluminum is commended for its lightness, strength and comparative freedom from rust. One of the drawbacks of commercial aluminum is its lack of uniform purity, the impure spots being easily acted on by moisture, especially if salt is present. Another is the low temperature at which it melts, compared with steel and other metals. Its conductivity is 63 per cent. of that of copper, but being so much lighter, its serviceability as a conductor of electricity is double that of copper, weight for weight. At Niagara Falls, for example, great conductors of aluminum are used to transmit electrical currents from the power-house to the works. The amount of aluminum in the conductors weighs 22,000 pounds. The same work in copper would require 48,000 pounds. Another disadvantage of aluminum is the difficulty of soldering or brazing it, though a good many fluxes are put forward as being efficient. Professor Trowbridge thinks that although aluminum may be used for overhead telegraph lines, it is barred from competition with copper in cable work for the reason that, in order to compete in electrical conductivity with copper, an aluminum wire must have nearly twice the section of a copper wire of the same conductivity. This increases the size of the cables and also increases the electrical capacity, which is detrimental to the transmission of electrical waves. It is suggested that the use of aluminum wire instead of copper would lead to a greater size of apparatus since the conducting parts would have to be approximately twice as big. So also the item of labor would be increased, for no mechanic would work with aluminum if he could take copper or brass. In summing up, Professor Trowbridge holds that, while aluminum may be said to be increasing in use, it has not yet become a dangerous competitor of copper. The world moves rapidly, however, and since Professor Trowbridge made his study on the subject, the new metal, magnalium—an alloy of aluminum and magnesium, mentioned in the November number of The Canadian Engineer—has been brought out in Germany, and this metal, it is claimed, will put aluminum in a much better position than it has yet reached. One of these points of improvement is said to be its suitability for wire, and if its conductivity is also increased, it will mean an important step in the electrical, as well as mechanical, trades.

—Speaking of the electric railway developments of Britain, a noteworthy feature of the scheme to convert the London Metropolitan District Underground Railway from steam to electricity is that the tenderers for the electrical equipment will be asked to conform to no specifications whatever. Sir William Preece, the consulting engineer, believes that in this way the bidders will have a free hand to design the best system of electric traction which modern skill can devise. The road has facilities for a service of twenty-two trains an hour, and all they ask is a plan that will enable them to handle all the passengers who use the road. Such a contract, amounting probably to £5,000,000 sterling, will be keenly competed for by the American, German, French and English engineering firms. The cable informs us that American bids are coming from the Westinghouse, the General Electric, and Thomson-Houston Companies. The British competitiors include Mather and Platt, the Brush Electric Company, Crompton & Co., Thos. Parker & Co., and Dick, Kerr, & Co. Germany is represented by the Allgemeine Elektrikstat Gesellschaft, Siemens Brothers, Schlukert and Co., and Felten and Guilleaume, while the Bregguet Electrique Company and MM. Houtin and Leblanc will attempt to secure the order for France.

—An American authority on gas goes into the reasons why gas engines have not made the headway they should have made, according to their mechanical efficiency. First he blames the gas companies themselves, who have devoted their attention to the heating and cooking business, as the chief aid to the lighting business, instead of to the power question. Coming to the question of competition with other motors, he dismisses the water motor as in general a weak competitor, because of the lack of pressure in some towns, and the growth of the meter system in others; though water motors are good and cheap of installation in many cases. The electric motor he considers to be the only rival the gas engine has to fear, and his views of this are summed up as follows: "The electric motor has as many advantages as the gas engine; the present cost of installing is less, and the elastic rates for operation have tended to enlarge their use. Their advocates claim as follows: They are compact, can be put often

CONTENTS OF THIS NUMBER:

	Page		Page
Aluminum vs. Copper	157	Metal Imports	171
Barnes, Dr Howard T.	160	Mechanical Refrigeration	172
Bulkheads, Longitudinal	159	Mining Matters	168
Can. Soc Civil Engineers	162	Miner's Inch	155
Can. Engineer, Sample Opinions	163	New Catalogues	171
Cables, Conductivity of	159	Pan-American Exhibition	iii
Chambly Dam, Bursting of	162	Personal	171
Electric Flashes	166	Railway Matters	168
Electric Rys, Gt. Britain & Canada	158	Reeve, Geo B.	159
Engineers' Club, Toronto	161	Robb Engineering Co.	160
Engineering Ethics	162	School of Mining, Kingston	161
Gas Engines, Competitors of	157	"Scottish King" and "La Bretagne"	158
Heat by Chemical Reaction	156	Throttle Valve, New	160
Industrial Notes	165	Water Motor, The "Demon"	iv
Imperial Trade Notes	171	Westinghouse Tesla Patents	158
London Electric Railways	157	Winnipeg Waterworks Accident	163
Marine News	170	Wireless Telegraphy	155

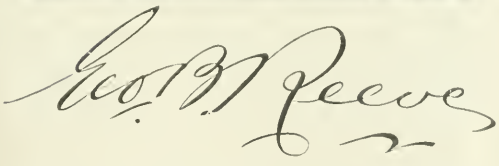
where a gas engine cannot, and can be connected or shifted easier; they require even less attention than a gas engine, need no water, require no effort to start, give no odor, take up less room, are cleaner, sound better than the exhaust of a gas engine, are handier and are up-to-date, modern, electric, and all that. Now this is, in the main, unquestionably an array of good points. Supplemented by the push of the competition from a score of makers, aided by questionably paying rates from the local electric company, they have undoubtedly done a large and growing business and checked the use of gas engines. As a rule, they give satisfaction. Now, I grant all this, but to get right down to the bottom of the matter, the real reason for their growth, to my mind, is not that—excepting in the smaller sizes—they are superior to gas motors, but because of two points; push and lower selling prices. It does seem to me that both these points can be met by the gas people, if they want to meet them, and understanding the real facts better will shake off the lethargy and passive acquiescence to a claimed superiority of the electric motor that to me it seems has largely dominated in the past."

—There is no country in the world where electric railways, for light inter-town traffic, have such a field as in Great Britain, and there is no country, having a high degree of civilization, where such enterprises have so far made so little headway. One reason of this is the remarkable respect in which private rights of ownership are held. Right of way is obtainable generally, only by purchase of land at prohibitory figures, and it is difficult even to run a wire over farm land. Another reason is the slowness and great cost of obtaining charters, as each incorporation has to be obtained by an act of the Imperial Parliament at frightful costs for legal services. Now, however, the great underground electric railway schemes of London have started the movement, and in spite of the difficulties of such enterprises, a number of lines are being built in various parts of the kingdom. These railways will be much better suited to the requirements of the great net-work of towns and villages of Britain than the light steam railways which the British Government has been lately encouraging by special legislation to enable the country districts to get over the handicap they now suffer through the cost of transportation by wagon from remote villages. As before mentioned, the energy and courage of a number of Canadian and American electric railway men has brought about this development of electric lines in the Old Country. Meanwhile the development of electric railways goes on apace in Canada and the United States, and the steam railway trunk line managers, after holding aloof for a long time, have at last come to recognize that the trolley lines can do for them what steam trains must fail to do, as local feeders. The progress of electric lines in Canada is shown by some striking figures, just gathered by George Johnson, Dominion statistician; During the year ended December 31st, 1899, the 34 electric railways of Canada had 630 miles of track which were so used that the total number of miles run by cars was 29,646,847. The number of passengers carried was 104,033,659 equal to carrying every man, woman and child in the Dominion twenty times. The mileage run and the passengers carried show that for each mile run the railways carried 3½ passengers. Compared with the previous year, the number of passengers carried increased nearly nine and one-half millions, and the number of miles run by over a million; the passengers carried per mile increased from 3½ to 4½. The number of transfers given in Toronto was over 10½ millions. These are not included in the total of passengers carried. The amount of paid-up capital invested in electric railways is $21,700,000. The steam railways in 1899 carried 16,168,191 passengers, running a train mileage of 25,292,856, thus making an average of 1½ passengers per mile. The electric cars traveled over 4 1-3 million miles more than the passenger and mixed trains of the steam railways. Together the steam and electric railways carried over 120 million passengers, and the proportion was about 13 by steam to 87 by electricity.

—The suits of the Westinghouse Electric Co., against the New England Granite Co., upon an infringement of the Tesla polyphase power transmission patents in the United States, have been decided in favor of the Westinghouse Company. There is nothing surprising in the decision, but the language of the judgment is remarkable for flowers of oratory, which we do not always associate with the sober sense of a judge. Here are two sample sentences: "It remained to the genius of Tesla to capture the unruly, unrestrained and hitherto opposing elements in the field of nature and art, and to harness them to draw the machines of man. It was he who first showed how to transform the toy of Arago into an engine of power; the 'laboratory experiment' of Baily into a practically successful motor; the indicator into a driver; he first conceived the idea that the very impediments of reversal in direction, the contradictions of alternations might be transformed into power-producing rotations, a whirling field of force." This judge must have been "intoxicated with the exuberance of his own verbosity."

—By an accident in making up the last number of The Engineer, the signature was dropped from the letter on the "Floating of the Scottish King." This interesting letter, recording the ingenuity of Capt. Bernier in floating the vessel by sealing up the sunken hull with cement, was written by Charles Baillairge, C.E., of Quebec, who in this number points out the cause of the disaster to the man-of-war "Victoria," and to the French liner "La Bretagne." It is to be hoped that these dreadful examples will be enough to warn modern shipbuilders against the longitudinal bulk-head folly.

—An item in last number showed how the life of rails of steam railways may be cut short through polarization due to constant traffic in one direction, and now a Mr. Rheims has discovered a parallel phenomenon in the action of the electric current on cables. It is observed that certain cables unaccountably lose their conducting properties and have to be replaced. Mr. Rheims gives, in a paper to the Academie des Sciences, his explanation of the cause. He states that when cables lose their electrical properties, it is because they are always used for one kind of current only, either positive or negative. If used sometimes for positive and sometimes for negative, they will, he states, preserve their conductive qualities indefinitely. He illustrates this by an observation on an underground line between Paris and Dijon, the line having nine wires. Of these, wire No. 7 received alternately positive and negative currents. This line kept its conducting properties, while the eight other wires, which were used with Morse and Hughes' instruments, and only received positive currents, had all lost more or less of their conductivity. The remedy for this loss was stated to be obvious—namely, that all currents sent in one direction should be positive, those in the contrary direction being negative, thus destroying the action of the first current by that of the second.



Since our last issue went to press George B. Reeve has been called from the retirement of a California fruit farm to assume the general managership of one of the greatest railway corporations in the world. When Charles M. Hays announced his retirement, to take charge of the Southern Pacific, the appointment of a successor left no easy problem to the directors. It must be a man of no ordinary qualities who could assume the mantle dropped by Mr. Hays. It is, therefore, the more satisfactory to know that when the name of Mr. Reeve was announced it was received with confident approval, not only by all branches of the service, but by the outside public. Mr. Reeve was born Oct. 23, 1840, in the county of Surrey, Eng., and, coming to Canada as a youth, entered the service of the Grand Trunk in 1860. He has been for forty years continuously in this service, working his way by his own energy and ability from the humble post of freight clerk, step by step, till he now stands at the top rung of the ladder of executive authority and responsibility. These stages were as follows: Freight clerk, May, 1860 to 1862; telegraph operator, 1862 to 1863; train despatcher, 1863 to 1865; relieving agent, 1865 to 1866; agent, 1866 to 1873; assistant general freight agent, 1873 to 1881; traffic manager, Chicago & Grand Trunk, 1881 to 1896, also traffic manager Chicago, Saginaw & Mackinaw Road from 1890 to 1896. On the advent of Mr. Hays in 1896 he was appointed general traffic manager of the whole Grand Trunk system, and from that date till his retirement these two men worked together as brothers in evolving a new Grand Trunk out of the old aggregation of roads. The vast improvement which has taken place in the traffic department of the system has been the special work of Mr. Reeve. To quote an appreciative sketch in the Montreal Gazette: "Every week morning when in Montreal they met in Sherbrooke street at 8.30, walked down together to the company's offices at Point St. Charles, and seldom quitted them before 6 p.m. They always lunched together in Mr. Hays' office, and in these ways found time to discuss more fully the works being carried on." Like Mr. Hays, he is not the man to let things drift, and his record as traffic manager is proof not only of his executive ability but his tremendous capacity for work. His personal knowledge of the railway systems of the United States and Canada fit him for the position of chief of a system which has such a large mileage in both countries; while his broad views and appreciation of public sentiment will always keep him in sympathy with all that is reasonable in the expectations of the people. It is interesting to note the fact that when Mr. Reeve retired last April, to spend the remainder of his days, as he thought, on the slopes of the Pacific, he was entertained by the officials of the different departments of the railway to a dinner at the Windsor, and presented with a massive cabinet of silver. With equally warm if less formal expressions of good will, these officials have welcomed him back as their chief. The Grand Trunk is fortunate in having such a president as Sir Charles Rivers Wilson, for the choice of both the late manager and the new manager is due to his judgment and sagacity. The portrait here presented is from Mr. Reeves' latest photograph.

LONGITUDINAL BULK HEADS IN OCEAN LINERS.

Editor CANADIAN ENGINEER :

DEAR SIR,—The new French liner, "La Bretagne," now plying between Havre and New York, is, says the Scientific American, 580 ft. long, 60 ft. beam, 39 ft. depth of hold. Her tonnage, 15,300 tons. She is divided transversely into some 18 compartments, by 17 water-tight bulk heads, and into additional sections by a longitudinal central partition, running fore and aft.

This longitudinal separation of the vesssel was the unfortunate feature in the "Victoria," sunk, it will be remembered, by the "Camperdown," during a review of Her Majesty's navy, a few years ago. The inrush of water, through the break in her side, was prevented by this central wall from spreading, as it would otherwise have done, to both sides of the vessel. She might have taken in a large quantity of water, and still have kept her plumb, but the water, by being thus heaped up on one side, caused the vessel to tilt over until her port holes dipped under water, when the vessel continued to fill and tilt more and more until under the heavy weight of her deck armament, she turned completely over, and went down with more than 400 souls on board.

Now, it is hardly two years since the very same thing happened to the "Gascoigne," a younger sister of the "Bretagne," and belonging to the same company. This vessel, like the "Victoria," was stoven in laterally. The water, as in the former case, being prevented by the longitudinal bulk

head from spreading over the whole breadth of the hold, was again heaped up on one side; the "Gascoigne" lurching and still continuing to lurch, until she was thrown on her beam-ends, and went down, with an appalling loss of life.

Has this dangerous feature in the construction of the "Victoria" and "Gascoigne" been overlooked, that it is repeated again in the new liner, "Bretagne," or are any new features introduced to conjure the danger threatened by a repetition of this ill-advised feature in each of these vessels? One can see of course, all the importance of such a longitudinal bulk head in or along the compartment or section of the vessel occupied by the engines and boilers, so that in case of an irruption of water putting out the nest of fires on that side, the opposite nest, laid back to back with the first, might still continue to drive the vessel at half speed. Now, Sir, could not this disposition to lurch over be counterbalanced by a conduit or pipe from each of the twin boiler compartments, to the adjoining fore or aft, or both of the double sections of the vessel, and by which, on opening a valve or gate in the conduit, the water might be allowed to flow to the opposite side of the vessel, in a way to counteract the inrush from the stoven-in side, and this without prejudice to the boilers still doing duty in said section?

Surely, Mr. Editor, this is a matter for most pertinent enquiry, and it would not be considered derogatory in you to venture an opinion in the premises, and throw out a suggestion, which, though from a journal not purporting to make a specialty of such subjects, might be taken up and acted on by our great naval architects of Europe and the United States.

CHAS. BAILLAIRGE, C.E..

DR. HOWARD T. BARNES.

Dr. Howard T. Barnes, who has recently been appointed senior lecturer in Physics, at McGill University, was born in Woburn, Massachusetts, in 1873, but has spent the greater part of his life in Montreal, where he received his university training, graduating at McGill in Science in 1893. He was for one year assistant to Dr. B. J. Harrington, in chemistry, and at about this time his first research work was done on the quantity of carbonic dioxide in the atmosphere in winter. In 1895 Dr. Barnes took up special work in the Physical Department of the University, and, for the three following years served as demonstrator in Physics. During this time, under the guidance of Prof. H. L. Callendar, some important work was done on electrical standards of E.M.F., and for two winters a careful study was made by Dr. Barnes, with the aid and sanction of the Harbor Commissioners, of Montreal, on the formation of frazil ice. In 1899, he received the Joule appropriation from the Royal Society, of London, to aid him in carrying out certain experiments on the specific heat of water and a determination of the mechanical equivalent of heat, in terms of the international electrical units. This work, which was begun conjointly with Prof. Callendar, by an entirely new method of calorimetry, was left in the entire charge of Dr. Barnes, soon after its commencement, by the removal of Prof. Callendar to London, and in June last, Dr. Barnes had the honor to give an account of his experiments before the Royal Society, of London, in whose philosophical Transactions his communications will shortly be published. In 1896, he received the degree of M.A.Sc., and last spring that of Doctor of Science. In 1899, he was awarded the Aberdeen medal for special research work. He has published a number of papers in the various leading scientific journals, including a paper on "Frazil and Anchor Ice," which appeared in The Canadian Engineer for May, 1897. Dr. Barnes is the son of the Rev. Wm. S. Barnes, who has been for many years minister of the Church of Messiah, in Montreal.

THE ROBB ENGINEERING CO.

The announcement that the Robb Engineering Co., Ltd., Amherst, N.S., is offering debentures and a limited amount of stock for the increase of the business, will be of interest to Canadian investors, as this company is known as one of the most enterprising and successful concerns in the Dominion. The Robb Company dates from 1848, when Alexander Robb, the founder, started in a small way at Amherst, N.S., so that he was the pioneer of manufacturing in that thriving town. For the past twenty-five years, the business has been conducted by the sons of the founder, who have grown up in it, and, therefore, have the benefit of practical training and experience of two generations in the same line. They were among the first to recognize the possibilities of the Maritime Provinces in the engineering line, which is bound to follow the development of mineral products, especially coal and iron, and about ten years ago, the Robb Engineering Co., Ltd., foreseeing the rapid growth of the uses of electricity, commenced the manufacture of a line of high-class engines, especially adapted to driving electric machinery. E. J. Armstrong, a clever and experienced American mechanical engineer, was engaged to assist them in designing engines and organizing workshops and special machinery to build these engines. They were fortunate, also, in being favored with the advice and assistance of Professor John E. Sweet, president of the Straight Line Engine Company, formerly instructor of mechanics at Cornell University, who is regarded as one of the best authorities of the United States in machine shop practice. Later on, while building engines for the Dominion Coal Co., Halifax Tramway, and other large corporations, under the direction of Dr. F. S. Pearson, of New York, consulting engineer for these companies, they received some very valuable advice from him. Dr. Pearson was chief engineer of the Metropolitan Traction Co., of New York, and formerly developed the electric street railway system of Boston, so that he has had more experience, perhaps, than almost any man in engines for electric railway purposes. As a result of this careful preparation, the Robb-Armstrong engines have found a demand in Great Britain, Spain, Australia, Cuba, Brazil, British Guiana, India, and many foreign countries, and the manufacturers of them have demonstrated that it is quite practicable to produce high-class machinery in Canada, and export it to any part of the world.

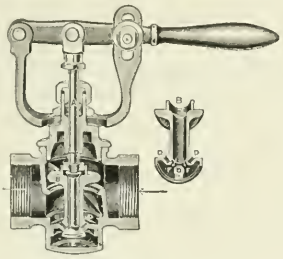
Engineering establishments form the groundwork of all industrial countries, because machinery, especially engines, must be used for almost every other branch of manufacture. From such small engineering concerns have sprung the great shipbuilding and engineering corporations of Great Britain, and if such establishments are conducted systematically, they will be found among the safest and most permanent investments, as they are in Great Britain and the United States. It goes without saying that a manufacturing business, which is already established, and has shown its ability to succeed and make money, forms a much safer investment than a new and untried venture, no matter how promising. The record already made by this enterprising company should ensure the most complete success in this move to increase their capital and facilities.

A NEW THROTTLE VALVE.

The Pendry-balanced throttle valve, shown in section in the accompanying cut, is particularly well adapted for use on hoisting engines, marine engines, steam shovels, and on all quick-acting engines, as by means of it the full boiler pressure can be instantly admitted to the cylinders and as instantly shut off. In addition to its quick-acting feature, it

is also a perfectly-balanced valve, and so can be very easily operated no matter how great the steam pressure being used.

Its operation is as follows: The stem A. forms two seats with the main valve, B, one at its upper, and one at its lower end. The first slight movement of the handle will raise the stem A. off its upper seat. The steam passes in through this opening, down through the body of the valve B., in the space around the stem, and into the balancing chamber E, through the openings marked F on the small sectional view of the valve body to the right. In this way the full boiler pressure is admitted into the chamber E. balancing the valve, and as the same pressure is below as above it, it is very easily operated.



It should also be remembered that while this valve is primarily a quick-opening one, it can be opened as slowly and as gradually as a screw stem valve, and it will stay open at any point you may desire to set it. This feature makes it adapted for use on all types of steam engines. The question of leakage can also be prevented in this valve, as it has but one seat and this can be ground the same as that of a globe valve. Circular, giving full description, may be had by addressing the manufacturers, The Detroit Lubricator Co., Detroit, Mich.

ENGINEERS' CLUB OF TORONTO.

The meeting of the Engineers' Club for November was held on the 6th Nov., at the new club rooms, which have recently been fitted up at 94-96 King street west. About thirty members were present. Reports of several committees were received. T. B. Speight tendered his resignation as treasurer, owing to the fact that he expected to be absent from the city for several months. C. M. Canniff was appointed as his successor. The following committees were appointed:

Finance Committee—H. F. Duck, Jas. McDougall and A. F. McCallum. House Committee—Major Gray, R. J. Parke and A. B. Lambe. Library Committee—W. T. Jennings, W. H. Patton and W. A. Clement.

A resolution of thanks was voted to the proprietors of the Rossin House for providing a room for meetings of the club during the past year. Notice was also given of several proposed amendments to the constitution, which will come up for discussion at the next regular meeting.

KINGSTON SCHOOL OF MINING

The contemplated electrical equipment for the School of Mining, Kingston, has already been begun in a small way by the purchase of standard electrical measuring instruments, to be used by Professor Gill for instruction purposes. The equipment will not be extended largely until the new building is completed. This building, the rental of which is provided by the Ontario Government, will be begun immediately, and may possibly be completed in time for next session. It will cost about $35,000, and will be devoted to the departments of Geology, Mineralogy and Engineering. One flat will be occupied by the Museum of Economic Geology and Mineralogy, and the attic story by the draughting department. The electrical equipment to be placed in this building will consist of standard generators, motors, and electric measuring instruments, space for which is provided in a large electrical laboratory. Lecture-room apparatus on a smaller scale will also be provided. The governors of the School of Mining are going largely upon faith in looking forward to the more expensive parts of this equipment; but, as the development of the School of Mining has been carried on successfully by a combination of faith and works, a successful issue in this case is confidently expected.

The Engineering Department of the School of Mining will get no share of the $50,000 bonus, voted by the city. The School of Mining is a distinct corporation from Queen's University. The University building, to be built with the bonus, will be devoted largely to the scientific departments of the University, namely, Botany and Physics, but class rooms will also be provided for other departments.

Dr. W. L. Goodwin.

Dr. W. L. Goodwin, Director of the School of Mining, Kingston, was born at Baie Verte, N.B., and was a student of Sackville College, where he won the Gilchrist scholarship at the matriculation for London University, at which he graduated as B.Sc. in 1881. In the meantime he had gained the Hope prize scholarship at Edinburgh. This scholarship is given to the student making the best record in laboratory work. Returning to Canada he was appointed Professor of Science in Sackville University, and in 1883 was appointed Professor of Chemistry at Queen's, in whose interests he has been a most enthusiastic worker.

Prof. L. W. Gill.

The appointment of L. W. Gill, B.A.Sc., to the important chair of mechanical and electrical engineering has already been announced in this journal. Mr. Gill is a native of Prince Edward Island, and is a graduate of McGill University, where he took a distinguished course. After graduating he was awarded by Her Majesty's Commissioners an Exhibition Research Scholarship, on which he carried on an important research in electricity, for one year at McGill, and for the second at Johns Hopkins. His report to the commissioners was so satisfactory that he had the honor and honor of having the scholarship offered him for a third year. Mr. Gill has lately been employed in the testing department of the Westinghouse Company, of East Pittsburgh. He thus comes to Queen's with the strong combination of high scientific attainments and practical experience.

ENGINEERING ETHICS.

Editor CANADIAN ENGINEER :

SIR,—Your reference (page 139, November, 1900), to the growing practice indulged in by Civil Engineers in the employ of Government and some of our leading institutions, of taking private work, is well and concisely put. I think, however, that before dismissing the subject, a few words might be said in this connection, for other branches of engineering, as also in regard to a remedy for the abuse, if such exists.

When a resident of Montreal, some years ago, I had business reasons for knowing that the cream of engineering practice, in many of its branches, was absorbed in the way you refer to. Let us note, for an instance, a university professor of mechanical engineering, who, not content with the salary appertaining to his office, engaged in a large and remunerative private practise, and kept a standing advertisement, announcing the same, in our leading journal, The Canadian Engineer." I say remunerative, having been informed that the fees he obtained, in one instance, for some boiler evaporation tests amounted to $1,500. Even while writing, my attention is called by the Toronto papers to fees charged by a professor in electrical engineering of $1,850 for some lighting tests. Professors in engineering institutions, engaging in private practise, have the advantage of the services of the students under them, and the free use of laboratories which have been lavishly equipped and magnificently endowed presumedly for another purpose. The practise of taking outside work, in some institutions, is followed even to the under professors, who may get a certain share of the work of lesser importance, with the chance of doubling their salaries thereby. We must pause, however, before blaming the parties engaged in such practise, since, in discussing this subject some years ago, it was held that these institutions could not afford to pay high enough salaries to induce high-class men, in all cases, to come from other countries to "teach our young ideas how to shoot," unless they were allowed to supplement their salaries in this way.

Of course, it is hard on those in private practise, who have no income at all outside of their professional earnings, and who pay their own assistants, provide their own office, laboratory, and equipment; but if any such are aggrieved, they should be heard from in no uncertain way.

If the rights of any lower class of labor are interfered with now-a-days, we soon hear from the labor society that represents its interest, so it is quite natural to suggest that a Canadian Society of Engineers take care of engineering interests in the same way. But right here there is another trouble. Such men as complained of will be found, by virtue of their ability and positions, to largely control the affairs of the society, and, indeed, it is very evident that the society itself, as now constituted, depends largely for its very existence on the influence, if not the prestige, of these men. Now, why should engineers who subscribe nothing to any society to have their interests represented expect others to look after their welfare. Every member of a laborer's union pays his fees or looks for no favors. So I hold that the fact of abuse existing, if such exists, is not so much to be blamed on these Government engineers, professors, etc., as on the class injuriously affected, who submit without a "kick" thereto. Of what use are the "unwritten laws," you refer to?" Does not the very surmise, that there may be something to "kick" about, suggest the necessity of a proper organization amongst those who toil in the various fields of engineering, so that written laws may be made, and the "kicks" become effective when these laws are broken? A central society, as is the Can. Soc. of Civil Engineers, is all right and indispensable in its way, but this complaint is an indication that it is only part way to supplying the representative needs of the engineering professions. An advance along this line, it is to be hoped, is being made by the formation of an Engineers' Club, in the City of Toronto, charging but a nominal fee for membership. Home quarters have been specially fitted up for its use, centrally located, where periodical meetings will be held, at which all matters appertaining to the professional advancement of its members, and of the professions embraced, will be legitimate objects for discussion. In the ranks of the Toronto Club will be found ex-presidents of the Canadian Society, and presidents that are to be, as well as members of its council and members of the society, as it now stands; so by engineers joining this club, they are at once in a connection reaching to the head society. So, to the profession generally, especially those of its members who are within occasional reach of Toronto, I say, join the club and help support it in accomplishing the legitimate objects of its existence; and to other cities and towns, I say, follow the example of the Queen City of the West, and organize the rank and file of the professions in your neighborhood in a similar way. Thus, our influence may be felt throughout the length and breadth of the land, not in opposition to the central organization, but as a voice from the people; it may be to chide, it may be to praise; but in the main let it be to uphold and strengthen its hands in righteousness, making it what it is not to-day, but what it aims to be—a truly representative Society of Canadian Engineers, to watch over our interests with fairness to all branches, as well as to give to engineers of this country a name and a standing in the engineering councils of the world.

ROBT. W. KING.

Toronto, 1st December, 1900.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The paper, summarized elsewhere, by Thomas Drummond, on "The miner's inch and the discharge of water through various orifices under low heads," was read at the meeting of the Canadian Society of Civil Engineers held in its rooms, 877 Dorchester street, on the 22nd November. Correspondence in connection with the subject from Chas. Baillairge, late city engineer of Quebec, and from Prof. W. R. Butler, Royal Military College, Kingston, was also read. An animated discussion followed the reading of the paper, being taken part in by Dr. J. B. Porter, professor of Mining, McGill University; E. G. Coker, assistant professor; H. Irwin, assistant engineer C.P.R.; W. J. Sproule, assistant engineer Harbor Commissioners, and other members. The president also addressed the meeting in connection with Mr. Drummond's investigations, the progress of which he had followed with considerable interest. He also gave the Society the benefit of certain recent hydraulic experiments which were being conducted in the laboratories of McGill University.

At the recent meeting of the Society in Ottawa an important discussion took place on the procuring of engineering literature for the Society. Amongst others, E. H. Keating and R. W. King, of Toronto; and R. Surtees, C. A. Bigger and O. Higman, of Ottawa, contributed towards the debate. In connection with it C. H. Keefer, of Ottawa, suggested the establishment of a Shanly Medal in commemoration of the late Walter Shanly. It was also proposed to erect a tablet in the rooms of the Society for Mr. Shanly.

BURSTING OF THE CHAMBLY DAM.

On the morning of Nov. 17th the big dam of the Chambly Power Co. on the Richelieu near Chambly, burst, carrying away about 185 feet of the dam, including 15 sluice gates, and causing a paralysis, for a few minutes, of the power used to convey light to the streets of Montreal. Fortunately, however, the Royal Electric Co., contractors for this power, had its steam plant in reserve, and lighting can be carried on in Montreal till repairs can be effected. As reported to the Montreal papers the damage was caused by the loosening of the concrete through the lifting and closing down of the sluice gates. A correspondent of The Canadian Engineer, however, who visited the spot, says that in designing the dam no sufficient allowance was made for the weakening effect of so many sluice gates placed close together, and further that the porous concrete used in building the dam was not properly protected. It was built, he says, with an American cement, an imitation of a sand cement made by grinding Portland cement, 1 to 1, with limestone. This cement is said to have been tested at McGill University, and to have been shown to be deficient in sand carrying capacity. The material, instead of being incorporated with a 6 inch or 8 inch armor of Portland cement, was simply plast-

ered over with a skin of neat cement not more than an inch thick. The skin began to crack and peel off some time ago, and— as our correspondent says was predicted—the porous material of the dam simply crumbled away. Attention appears to have been called to this before, and in fact steps were being taken to effect repairs when the accident occurred.

When the gates and dam were carried away the company set to work energetically to restore the works, building a coffer dam about the broken dam at a cost of $10,000. The permanent dam is now being replaced at a probable cost of $28,000, and it is expected current will be turned on before the close of the month. Meantime, advantage will be taken of the stoppage to improve the system of transforming. Mr. Forget, president of the Royal Electric Co., gave the following statement: "We were generating at the time of the accident 10,000-h.p., and by May, when all the machinery is ready, our full complement of 20,000-h.p. will be available. The break will not affect our calculations. As for the 10,000, which has been stopped for three or four weeks, this quantity has been replaced by the east end station, which will light the streets, while the incandescent light and power will come from the Queen street station. The Lachine Hydraulic Company also kindly came to our assistance, and helped us out at the cotton mill. Stillwell, Bierce & Co., of Pittsburg, Pa., were the contractors, and are consequently responsible to the company for the character of the work at Chambly. The repairs will be done by Peter Lyall & Sons, in connection with an American expert."

SAMPLE OPINIONS.

I enclose herewith $1, being my subscription for The Canadian Engineer for 1900. Your paper becomes more valuable each month. Wishing you well, I remain, yours truly,

E. A. Forward, C.E., Dickinson's Landing.

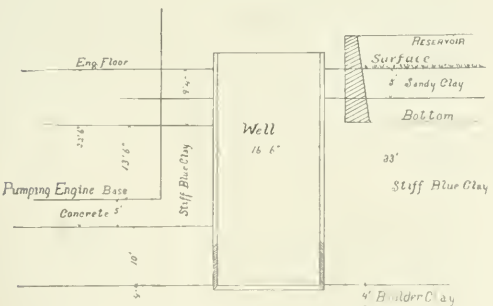
Please find $1 for Engineer, which proves so very interesting and instructive. Like good old whiskey, it improves with age.

John D. Ronald,
Manufacturer fire engines, Brussels, Ont.

ACCIDENT TO THE WINNIPEG WATERWORKS

The nature of the mishap which occurred in August last to the new waterworks plant at Winnipeg will be made clear to our readers by the accompanying diagrams and the appended information, taken in part from the report (as printed in the Winnipeg Tribune and Free Press), of W. T. Jennings, C.E., of Toronto, who was called in to investigate the difficulty and suggest a remedy.

The city of Winnipeg hitherto obtained its supply of water from the Assiniboine River, but the settlement of the country drained by that river made it obligatory that a change should be made. Accordingly, on the advice of Rudolph Hering, C.E., it was decided to sink a series of artesian wells on a line extending northerly and to the west of the city, and thus intercept the large stores of water contained in the water-bearing strata which formed the bed of the ancient "Lake Agassiz," which in bygone ages covered an area five times that of Lake Superior.



Winnipeg Waterworks—Section of Well and Character of Soil in which Built

Accordingly, a brick-curbed well, 16 feet 6 inches in diameter, was sunk through the Red River soil and stiff clay for a distance of some 38 feet, to a water-bearing strata of boulders, silt and sand some 5 feet in thickness, which surmounted the solid rock at a point west of McPhillips street, where the pumping station had already been erected. The well was situated some 9 feet from the end wall of the engine house, immediately behind which the large pumping engines were founded on a 5 foot block of concrete, the base of which was 14 feet above bed rock. The concrete base, 24 feet square, for the chimney stack, was situated within 12 feet of the side of the well. The weight of the chimney, 125 feet in height, is estimated at 700 tons.

It was expected that each of the wells would furnish about a quarter of a million gallons of water per day, and that the well sunk near the pump-house would be used more as a receiving well than one of the series forming the supply. However, on reaching the water bearing strata the inrush of water was so great that the economically inclined aldermen concluded that the problem was already solved and that the expense of other wells with their connecting pipe line need not be entailed. Accordingly measures were taken by the use of temporary pumping apparatus to reduce the level of the water in the well, that the suction and other pipes might be placed therein and connected with the pumps.

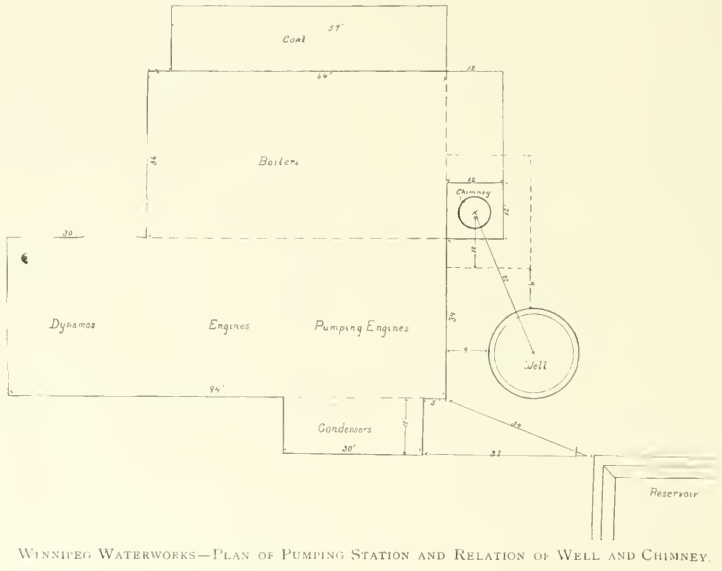
The great inflow of water through the loose material on which the bottom of the well curb rested, immediately eroded the loose material under, and to a distance of 8 or 10 feet beyond, the periphery of the well, thus leaving a void underneath the curb. The saturated condition of the ground through the flooding, pumping and heavy rain storms, which occurred at the time, doubtless softened the material so that the curb sank to within 2 feet of the rock, and with its settlement the surrounding soil was depressed. The connecting pipes were smashed and the chimney took a set of some 15 inches towards the well.

To overcome the difficulty and to prevent further settlement of the well curb, it was supported by the introduction of iron pillars resting on the rock. To prevent further erosion of the loose material overlying the rock and under the curb, all voids were filled by sacked concrete laid in by a diver. The inside of the well was then cleared of clay and filled up for about 6 or 7 feet with broken stone on top of which was placed 3 feet of concrete. Leading from the broken stone, through the concrete, were placed four 8 inch pipes, reducing to 6 inches, with valves above the concrete. It is not quite certain whether the settlement in the walls of the building was caused by disturbance of earth from the flow of water, or by the partial caving in of the pipe trench, which had been dug under the building to make connection between the pumping pit and the well. The pumps had been running about a month without the appearance of quicksand in the water, and it was then thought that no difficulty would arise from this cause. However the damage to the walls was not serious, and the chimney has been righted by digging under the opposite side of the foundation. The following are extracts from Mr. Jennings' report on the case:

The general arrangement of the buildings and works is unnecessarily crowded, and to this is due a part of the trouble. Straining for economy has led to the introduction of the lighting plant with its engines and dynamos, in the pump room, which is none too large for its special purposes when space is provided for repair tools and supplies, also a room for the officer in charge. The chimney stack should have been erected on a full base of its own, and situated entirely free from connection with the walls of the building, also as remote as possible from the pumping engine pit, which the chimney base adjoins, and at an elevation of 13 feet above the engine beds. The depth of the concrete block upon which the pumping engines are placed leaves but a ten foot layer of clay between its base and the bed of boulders, sand and clay, while the central position of the engines is only some 36 feet from that of the well. Thus will readily be discerned the probable result should the material underlying the engine bed and vicinity be loosened by vibration and removed by suction of water. The pumping well, 20 feet in diameter, built of brick, and situated on the north of the pump house, some nine feet, and the like distance from the northeast angle of the chimney base was, I

understand, intended as a receiver of water from a series of wells to be sunk, but upon sinking the curb to the water bearing strata (which was a mistake),there occurred a sudden inrush of water exceeding the required daily supply, which rising to the surface, some 42 feet, above rock level, was only prevented from flooding the works by the use of powerful pumps. The altogether too close proximity of the well to the buildings and foundations makes its situation impracticable, especially as it is evident that the water removed carries clay in suspension, this pointing to the loosening and removal of the matrix forming a great part of the underlying 4 feet bed of gravel and boulders. The result of such disintegration was demonstrated by the sudden settlement of the well curb for 2 feet, or to about a like distance from rock level; a consequent breaking of the suction pipe, which by this time had been placed in position (in the well) and connected with the pumps, also by loosening the supports under the north wall of the pump house. To add to the jeopardy of the works an unprecedented rainfall of three inches occurred within 24 hours, and while the trenches excavated for the introduction of the pipes to the well and pure

that drainage connections with the main sewer were not made before other operations were commenced. These connections should, of course, include provision for the overflow and drainage from the pure water and other tanks. The sealing of the well and the replacing of material (so far removed) with concrete should make the bed firm for both chimney and engines, but if this is not satisfactorily accomplished, trouble will occur later on through settlement due to these concentrated loads. I examined samples of clay taken from under the chimney and engine beds, and from its texture feel satisfied that the engineer was justified in founding thereon. The concrete bottom of the pure water tank should be strengthened (to make up for possible defects in soil), by an additional 8-inch layer of concrete, which should meet the sides of the reservoir in cove or concave sweep. This will also facilitate cleaning operations. The hoops and fastenings of the large tubs in the softening house should be tested and additional bands added if found necessary. Overflow pipes should be fitted to all tanks or other receptacles for water in this building. The excavation made under the boiler house floor to facilitate the straightening of the chimney



Winnipeg Waterworks—Plan of Pumping Station and Relation of Well and Chimney.

water tanks were yet open. The ground under and about the chimney and wall foundations being thus saturated a settlement of the chimney occurred on the weaker side of its foundation, viz., adjoining the well. The report concludes: "The city engineer was advised to order the erection of a shed over the affected area north of the pump house, also the removal of the down water spout to prevent further deposit of rain water thereon. I advise the sealing up of the well to at least the engine bed level without a moment's delay, by using a diver to solidly pack with rich concrete all voids found under and behind the curb, commencing first on the southerly side as being nearest the chimney and engine foundations, after which, if circumstances demand it by a continual flow of water, to place a flange faced bend under the curb on the northwest, and connect it with an up take relief pipe threaded for a closing cap. To prevent the uprising of water around the outside of the brick well curb the present clay material should be carefully removed for three feet, or such further distance as may be found advisable, and the space thus formed refilled with concrete and thoroughly well compacted clay. One or more new wells should at once be sunk to the north or northwest of the present well, and at not less than 100 yards therefrom, connected with the pumps in the usual manner. The foundation of the chimney be reinforced by the addition of a sub base of concrete under, about and united to it. The placing of piles to bed rock for support of any of the structure should only be considered as a last resort, as their intrusion through the clay to the water bearing stratum would certainly permit the water to rise by passing up the unavoidable spaces surrounding them. It is to be regretted should be filled with concrete placed under and about base of the chimney foundation. Drainage should be provided for "spill" from the feed pumps situated in north end of the boiler house and on the chimney base. The ceiling of the pump house should be provided with ventilating appliances extending to adjustable openings in the roof. The electric light plant, consisting of engines, dynamos and shafting, should be removed to a separate building, as now too crowded, badly arranged, and the dynamos are in danger of failing through excessive heat in the chamber when all the engines are in operation. The separation of the water and light plants will reduce liability to destruction by fire, and at the same time make insurance cheaper."

A company known as the Mineral Products Co., of which Russell P. Hoyt is manager, has been considering offers from the cities of St. John and Moncton, N.B., for the erection of a smelter. The capacity of the proposed furnace is 100 tons per day. Manganese ore will be used and the product is to be shipped to the United States.

As a good model of art in advertising we commend those interested to the space of J. H. Williams & Co., Brooklyn, N.Y. The change of this firm's matter sent in for this month struck us as being so good, not only in the cleverly hit points of a wrench but in the design and the neatness of penmanship, that we have thought it worth reproducing exactly as the "copy" was furnished for the printer. It is a study in the art of writing advertisements.

Industrial Notes.

The workshops of the Pontiac and Pacific Junction Ry. will be located at Hull.

The Robertson-Taylor Mnfg. Co. has built its new factory at Guelph to make cream separators.

Findlay Bros., Carleton Place, offer to double the size of their foundry if the town will lend them $10,000.

The Peerless Wire Co. have started a factory in Hamilton, Ont., for drawing double-tinned mattress and broom wire.

Schultz Bros., Brantford, have been awarded the contract for the erection of the new building for the Bank of Commerce, Paris, Ont.

Winnipeg will vote this month on a bylaw for a fire alarm system, new police stations and fire halls, and other municipal works, costing $144,000.

W. H. Frost, Smith's Falls, after finishing a brick addition, 40 by 57 feet, to his malleable iron works, is about to erect another building 270 feet long.

The Moore Shaft Coupling Co., Canterbury, N.B., has been incorporated with a capital of $5,000 to acquire the patent rights of the Moore shaft coupling.

This year's lumber cut of the Ottawa and Gatineau rivers, within a distance of 50 miles of Ottawa city, amounts to between eight and nine hundred million feet.

The Canadian Oak Belting Co., of Montreal, has amalgamated with the McLaren & McCrady tannery business at Brockville, and the belting works will be moved to Brockville.

Medicine Hat will operate its new waterworks system with power obtained from natural gas, which abounds in the vicinity. A lime kiln at Medicine Hat now uses natural gas for burning lime.

The New Process Raw Hide Co., of Syracuse, N.Y., have something to say in another column about pinions that are both noiseless and durable. There are some interesting points about gear made of raw hide—of which more will be said in a later issue.

J. A. Hunter, H. Parker, G. McKechnie, James M. Hunter, David Jamieson and William Calder, all of Durham, Ont., have been incorporated as the Durham Portland Cement Company, to manufacture and deal in Portland cement, etc. Capital, $150,000; head office, Durham, Ont.

The Art Metropole is now installed in its spacious new premises, 149 Yonge street, Toronto, and its showrooms of mathematical and surveyor's instruments, drawing instruments, etc., is the finest in Toronto. The progress of this firm has been most gratifying to themselves and friends.

Sir Wm. Van Horne, R. B. Angus, C. R. Hosmer, of Montreal; E. B. Osler and W. D. Matthews, of Toronto, have formed a company called the Pacific Coal Co., with a capital of $4,000,000, to mine coal and other minerals, and carry on manufacturing, etc. The head office will be Montreal.

The Canada Cycle and Motor Co. and the National Cycle and Automobile Co., of Toronto, have amalgamated under the name of the former company. W. E. H. Massey has been elected president. Hon. Geo. A. Cox, first vice-president; J. W. Flavelle, second vice president, and Joseph N. Shenstone, secretary.

The Truro, N.S., Foundry and Machine Company is shipping steel plating for the New York Bridge Company, contractors for the Shubenacadie Bridge, to protect the piers from the ice. It takes about 10 tons of steel plating to each pier. Efforts are being made to finish this bridge before winter sets in.

The employees of James Warnock & Co., Galt, held their second annual supper on the 10th ult. Manager Hayhurst, to whose energy and business ability this prosperous edge tool works owes so much of its progress, gave an interesting sketch of the history of the business, which dates back to 1844. Judging by the reports of the gathering that appeared in the Galt papers the musical and literary talent among the employees of the firm is distinctly above the average.

C. L. Meyer informs the mayor of Kingston that the plans for the smelter for that city are nearly ready and that building will soon commence.

The Meriden Britannia Co., Hamilton, Ont., has been converted into a joint stock company; capital, $50,000; provisional directors, J. E. Parker, J. W. Millard and J. G. Gould.

Davis & Sons, Kingston, are enlarging their ship building plant. They are now building a 60-foot yacht for James Pendergast, of Cornwall, and a 45-foot yacht for Geo. V. Forman, of Buffalo.

The Cardigan Overshoe Co., Stratford, Ont., has been changed into a joint stock company; capital, $20,000; provisional directors, R. M. Ballantyne, K. C. Turnbull and W. Willocks.

The Macdonald Mnfg. Co., Toronto, has been changed into a joint stock company; capital, $125,000; provisional directors, William Tassie, Albert Edward Donovan and August Wulff.

The Wright Hat Company, London, Ont., has been converted into a joint stock company; capital, $40,000; provisional directors, B. G. H. Wright, S. A. Wright, N. Rowell, M. C. Rowell and N. W. Rowell.

The George McPherson Shoe Mnfg. Co., Toronto, is now a joint stock company., capital, $40,000; provisional directors, Elizabeth McPherson, Frank O'Connor Higgins, Emma O'Sullivan, Stafford Higgins and James Edward Day.

L. J. Elliott, O. L. Parmenter, R. T. Robinson, E. B. Hand, Racine, Wis., and L. P. Bouvier, Toronto, have been incorporated as the Paper Goods Co., Ltd., to manufacture paper goods, etc.; head office, Toronto; provisional directors, L. J. Elliott, O. L. Parmenter and L. P. Bouvier.

A. L. Eastmure, F. J. Lightbourne, F. J. Baigent, W. H. Hazlitt and R. G. Baigent, Toronto, have been incorporated as the Queen City Plate Glass and Mirror Company, Ltd., to manufacture, sell and deal in glass; head office, Toronto; provisional directors, A. L. Eastmure, F. J. Lightbourne and F. J. Baigent.

The Otto Higel Co., manufacturers of piano actions, and Augustus Newell & Co., makers of organ reeds, keys, etc., both of Toronto, are amalgamating under the name of the Newell & Higel Co., to manufacture and sell musical instruments and parts thereof. The incorporators are: J. N. Shenstone, F. H. Wright, O. Higel, C. E. Clinkenbroomer, H. P. Nasmith, L. O. Kerr and J. H. Ewart; capital, $250,000.

The Montreal Pipe Foundry Co. have recently filled orders from the following municipalities, for supplies of the "G. N. Robertson" Catch Basin and Trap: Montreal West, Westmount, Cornwall, Hull, Outremont, Verdun, as well as from a number of western points. Municipal corporations contemplating extension or improvements to their drainage systems would do well in examining into the merits of this gulley.

The McKinnon Dash & Hardware Co., of St. Catharines, Ltd., and the Niagara Falls Metal Works Co., Ltd., have amalgamated and formed a joint stock company under the name of the McKinnon Dash & Metal Works Co., Ltd. Capital, $400,000; head office, St. Catharines; provisional directors, L. E. McKinnon, J. N. McRae and G. J. Armstrong.

W. R. Hall, G. N. Witherspoon, W. W. Turner, F. F. Quinn, G. W. Sulman, W. D. Sheldon, G. G. Taylor, Chas. Hadley, W. W. Scane, J. W. Carswell, Chatham, Ont., and T. J. H. Smith, Mount Clemens, Mich., have been incorporated as the Chatham Mineral Water Co., Ltd., to operate a certain mineral well in Kent county. Head office, Chatham; capital, $15,000; provisional directors, W. R. Hall, G. N. Witherspoon, F. F. Quinn, C. Hadley, W. W. Turner, G. W. Sulman, W. W. Scane, J. W. Carswell, W. D. Sheldon, G. G. Taylor and T. J. H. Smith.

During the past eighteen months the population of Sydney, N.S., has increased from 4,500 to 10,000, owing to the operations of the Dominion Steel and Iron Co., which now has two blast furnaces in operation, and early next year will have two more. Four thousand men will be employed at the iron works next year, and the surplus labor of the part of the country has been so drawn on that it is hard to get men for the

coal mines. The four furnaces will be able to smelt 400 tons a day. The 400 coke ovens are being got into shape, and it is thought that the steel plant will be in operation about the middle of 1901. The company will ship steel rails to Europe in competition with the United States manufacturers. The works will cover 480 acres, and are the largest ever built as a single undertaking. It is expected that 500,000 tons of pig iron will be produced in 1901, most of which will be converted into steel. About $5,000,000 has already been spent for buildings and machinery, and the entire plant will cost about $10,000,000.

A grindstone, four feet in diameter, and 7 inches thick, burst in the establishment of Gilmour Bros. & Co., Montreal, on the 30th Nov., and fragments were hurled into the adjoining factory of F. E. Came, killing one man and seriously injuring two others. The wheel was known to have two cracks in it for some time, and was running at 1,200 revolutions per minute when it burst.

Electric Flashes.

The Canadian Carpet Co., of Milton, have ordered an incandescent light dynamo from the Jones & Moore Electric Company.

The British America Corporation of Rossland, B.C., has ordered a 100-h.p. induction motor for their mines, from the Can. Gen. Electric Co.

The Welland, Ont., electric light plant, owned by C. J. Page, was completely destroyed by fire on Nov. 27th. The building was insured for $5,000.

The Toronto City Dairy Co. have ordered from the Jones & Moore Electric Co., 40-h.p. in direct current motors for their new works now under construction.

Nerlich & Co., Toronto, are putting in a lighting and power plant. The generator is a 35-k.w. Can. Gen. Electric Co. machine, direct connected to the engine.

The West Kootenay, B.C., Power and Light Co. purpose increasing the capacity of their plant at Bonnington by 10,000 h.p. The cost of the work is estimated at $1,000,000.

The Lynn Electrical Company, Brantford, have completed their contract for installing a large 500 volt multipolar dynamo, and several special wound motors for the Central Peat Co., Welland.

The Jones & Moore Electric Co. have received an order from the Cordova Exploration Co. for a 600-light incandescent plant complete with generators, marble switchboard, and all construction work.

The Jones & Moore Electric Co. have recently sold electric motors to the following: The Murray Printing Co., G. S. Brintrell, W. Tisech & Co., the Chandler & Massey Co., Ltd., Vancouver Electric Works (2), Douglas Bros., J. Desrivieres.

The capital stock of the New Brunswick Telephone Co., Fredericton, N.B., has been increased from $150,000 to $250,000 in 5,000 shares of $50 each, and the company's line from Fredericton to Chatham and Miramichi district will shortly be in operation.

The Toronto Railway Co. will, in the spring, extend its line from the present terminus in East Toronto to the village of Little York. A new steel bridge on stone abutments will be built over the Grand Trunk lines to enable this extension to be carried out.

The ratepayers of Woodstock, Ont., have passed the bylaw providing for the purchase and renewal of the present electric light plant for $30,000. Of this amount $1,400 is for the present building, and $1,600 is for the renewal of the plant. It is proposed to run the plant in connection with the waterworks, which are already owned by the town.

At the recent meeting of the Montreal Water Committee, the acting superintendent, Geo. Janin, reported on the tenders received for the new electric pumps. All were above the amount available, which was $30,000. The lowest tender was $27,000, which, with the cost of constructing a building, would make $36,000 in all.

The Canadian General Electric Co. is putting into the St. Vincent de Paul penitentiary, Que., two generators, one of 75-k.w., and one of 30-k.w. capacity, direct connected to engines.

The corporation of East Toronto is putting in a plant for arc and incandescent lighting from the Can. Gen. Electric Co. Its capacity is 1,000 incandescent lights, and 25 arc lights, on the plan known as the constant series alternating street lighting system.

It is said that Dean & Shibley, of New York, have made terms with the city of Belleville, for the purchase of its gas, electric and street railway franchises; and that they have also secured the Trent River waterpower at Trenton, and are negotiating for power at Campbellford.

The Marmora Electric Light Company have secured an hydraulic power from Messrs. Pearce, and are installing a 1,000-light alternating current generator, with S.K.C. transformers, etc., from the Royal Electric Company, Montreal. They expect to be in operation before the extreme cold weather sets in.

The Hutton Electric Co., of Brampton and Huttonville, who had their plant destroyed by fire this spring, and who have been operating temporarily since, have purchased from the Royal Electric Co. one 1,500-light alternating current generator, and one 50-light arc machine. These are in use at the hydraulic power house at Huttonville.

On the 1st Nov. the Gravenhurst electric light plant was destroyed by fire. The blaze is supposed to have started in the smoke-stack. The only piece of machinery saved was the exciter. Loss, $7,000; insurance, $3,000. A new plant has been erected, the building being brick instead of wood. The generator is a 75-k.w. machine of the S.K.C. type. The company will also light the Consumptive Sanitarium, which requires 250 lights.

The Edwardsburg Starch Works, of Cardinal, Ont., who had the misfortune to lose their large factory by fire about three months ago, have entirely rebuilt the premises, and are installing a complete electric light and power plant, consisting of two 50-k.w., S.K.C., generators, with switchboards, transformers and motors complete, making it one of the latest and most up-to-date plants in Canada.

The Toronto Board of Control has awarded the contract for high candle power lighting on the city streets to the Toronto Electric Light Company, at $74.82½ per light per annum, being at the same rate as last year. The wages clause is inserted in the new contract, providing for 25 cents per hour for the employees. The contract for low candle power lighting was awarded to the Carbon Light and Power Company at $31 for the first 1,000 lights and $33 for lamps above that number. The new company is an American concern, but agrees to manufacture everything in Toronto, starting a factory for that purpose.

Shipment was made a few days ago of the largest motor that has yet been built in Canada. The motor was consigned to the British America Corporation, of Rossland, B.C., and the shipment made by the Royal Electric Company, Montreal. The motor is an S.K.C. twophase machine, and its capacity is over 1,000-h.p., and is to be used to drive the compressors and hoists at the mines. The total weight of the motor, boxed, ready for shipment, was 105,000 pounds or 52½ tons. The weight complete of the motor, with its accessories, was over 120,000 pounds or 60 tons, requiring two full cars to transport it.

The corporation of Newmarket, who four years ago undertook the operation of the electric lighting plant for street as well as commercial lighting, and who at that time installed a complete, up-to-date plant, consisting of slow speed condensing engines, S.K.C. generators and wood arc dynamo, have found it necessary, in order to keep up with the demand for additional street as well as indoor lighting, to increase their plant, and have placed their order with the Goldie & McCulloch Co., of Galt, for a 250-h.p. Wheelock engine, and have also given their order to the Royal Electric Co. for an additional 100 k.w., S.K.C., twophase dynamo with the necessary station accessories and transformers. This town will possess, for its size, one of the most modern and up-to-date plants to be found in Canada.

Pratt & Letchworth, Brantford, have placed in their new factory a 30-h.p., S.K.C., twophase motor which is operating from the lines of the Brantford Electric & Operating Co.

The Institute for the Blind, Brantford, is installing a two-phase S.K.C. motor for power purposes, the current being supplied by the Brantford Electric & Operating Company.

The Central Electric Co., of Portage la Prairie, Man., have just installed and placed in operation a 150-k.w., S.K.C., twophase alternator. They contemplate going into the power business.

The War Eagle Mining Co., of Rossland, B.C., have placed their order with the Royal Electric Co. for one of their two-phase 20-h.p., S.K.C., induction motors. This is one of a series of motors that will be installed by these people for small power purposes in and about their mines.

Dr. Groves, owner of the electric lighting plant at Fergus, has installed in his power-house a 75-k.w., S.K.C., twophase alternating current generator, made by the Royal Electric Company, Montreal. The doctor intends to supply power as well as light to the town.

The town of Parrsboro, N.S., has taken up the municipal lighting question, and has placed an order with the Royal Electric Co., for one 50-k.w., S.K.C., twophase generator, and 500 lights capacity in transformers and wiring supplies. It is expected that the plant will be in operation by the first of the new year.

Dr. Thompson, of Cayuga, the owner of the electric lighting plant there, and whose power house was destroyed by fire some six weeks ago, is rebuilding, and has placed his order with the Royal Electric Company for a 750-light alternating current dynamo with the necessary station accessories.

Brandon, McDougal & Austin, owners of the Fenelon Falls electric light plant, have found it necessary to increase their lighting capacity, and have placed an order with the Royal Electric Co. for one of their 75-k.w., S.K.C., twophase generators, as well as for a number of transformers, and a stock of supplies, and intend overhauling and improving their present plant.

Fair & Sargent, of Bancroft, Ont., are about to put in an electric lighting plant in that town. They have placed their order with the Royal Electric Co. for two direct current generators, that have a capacity of about 500 lights, also the necessary supplies. This enterprising firm deserve success in their venture. They expect to have the lights in operation by Christmas.

James A. Spence, of Colborne, Ont., owner of the electric lighting plant, and who was unfortunate enough to have his plant destroyed by fire a short time ago, is rebuilding, and has placed his order with the Royal Electric Company for a 75-k.w., S.K.C., generator, complete with exciter and station apparatus. They were in running order three weeks after the fire.

Donald McIntyre, who owns a water power about three miles north of Paisley, Ont., has found it necessary to increase his electric lighting plant. He has ordered from the Royal Electric Co., one of their 60-k.w., S.K.C., twophase alternating current generators, and has added a third wire to his lines from the water power to the town, thus placing himself in a position to furnish power as well as light.

The Perth Water & Electric Co. have been operating their water system by electrically driven pumps from their lighting station, and where they have had a 150-k.w., S.K.C., generator in operation for the past two years, have found it necessary to increase their plant both for power and light, and have placed their order with the Royal Electric Co. for one of their 200-k.w., S.K.C., twophase generators which is being installed to work in parallel with their present outfit.

The Nickel-Copper Co., of Ontario, whose large refining works are at Hamilton, have begun operations on a large scale, and have placed in their new power-house two 240-k.w., and one 75-k.w., S.K.C., generators; the former to drive the dynamos for the electrolytic process and the latter to drive the ore process. These three machines are being used as synchronous motors, taking the current from the Cataract Power Company's lines at 2,400 volts.

Woodstock, Ont., has carried the bylaw to buy out the electric plant at $30,000, and run it as a municipal concern in connection with the waterworks, which are already owned by the town.

Lachine, Que., is disposing of its municipal plant, to accept the offer of the Lachine Rapids Company for current. The system will be remodeled for alternating current for light and power.

The civic lighting committee of Kingston has recommended that the city put in a municipal electric lighting plant at $50,000, rather than arbitrate with the company, as it is claimed that a clause in the agreement puts it outside the Conmee Act.

The corporation of Bridgewater, N.S., have found it necessary to increase their incandescent lighting capacity, and for this purpose have placed their order with the Royal Electric Co. for one 80-k.w., S.K.C., generator, with the necessary switchboard, etc.

The Brantford Electric & Operating Company, who have been operating a 180-k.w., S.K.C., machine for the past two years, have just started an additional 360-k.w., of the same make, twophase generator, furnished them by the Royal Electric Co., Montreal. This gives them a total capacity of nearly 600-k.w.

The Dominion Coal Company, Glace Bay, N.S., is putting in a Canadian General 30-k.w. dynamo for lighting its wharves at Louisburg. The same company will light its Cape Breton and Glace Bay mines by electricity, and is purchasing three C.G.E. generators of 35-k.w. each, with complete switchboard equipments, for that purpose. The company is also adopting electric locomotives for mine haulage, and has placed an order for a special type of mining locomotive with the Canadian General Electric Co.

The 40th annual meeting of the Montreal Street Railway was held last month. Mr. Wanklyn, the manager, stated that on the 6th Nov. power was received by the street railway, for the first time, from Chambly. The amount was 500-h.p., but an additional 750-h.p. is expected before the new year, making 1,250 h.p. altogether. The president said that the increased capital, compared with last year, amounted to $497,000, and that no further capital would be called up until the company needed it. He considered it necessary to maintain a good cash reserve, so as to secure the payment of the 10 per cent. dividend no matter what contingencies might come. James Ross spoke a few words about the cost of accidents. Three years ago the accidents and attendant law costs amounted to 3½ per cent. of the income, but in the last two years it had been less than 1 per cent. Including transfers, 56,000,000 people got on and off the cars in Montreal every year, and the few accidents was a matter for congratulation. The directors were then re-elected as follows: Hon. L. J. Forget, president; James Ross, vice-president and managing director; K. W. Blackwell, F. C. Henshaw and H. Montagu Allan.

The following from The Montreal Star is given for what it is worth: Frederick Nichols, general manager of the Canadian General Electric Company, whose headquarters are at Peterboro, Ont., was in the city yesterday on business, it is understood, with the Royal Electric Company, which is reported to be about to dispose of its manufacturing business to the Canadian company for a consideration of three-quarters of a million dollars. Such a deal has been talked about in the street for some time, and the presence of Mr. Nichols and his visit to the office of the president of the Royal Company gave rise to the report that the deal had been consummated. The interested parties are reticent on that point. The acquisition by the Canadian General Co. of the large plant and goodwill of the extensive patronage of the Royal Co.'s manufacturing business would practically give them a monopoly of the business in Canada. The Royal Company would then be left with a clear hand to pursue to a conclusion some of the ambitious schemes which are credited in the street to the master hand which guides its destinies. One of the first of these is alleged to be the acquisition of the Gas Company and the Lachine Rapids Company, thus practically controlling the lighting business in the city. After that it is proposed to amalgamate all the electric railway lines on the island under one great system.

The Woodstock, Thames Valley and Ingersoll Electric railway was officially opened on Nov. 8th, although the entire route is not yet completed.

J. F. Webb, of Ypsilanti, who is promoting the new inter-lake street car line from Windsor to Leamington, Ont., says the line is assured and operations for building same will begin in the spring. The company will be organized within a very short time with a capital of $500,000.

The Brandon, Man., Electric Light Co. is now building a power dam on the Little Saskatchewan, about 10 miles from town. By this means about 800-h.p. can be developed, and this can be increased later. Dynamos are to be put in next spring, when both power and light will be furnished.

The Canadian Gold Fields Co., Ltd., Deloro, Ont., who own extensive gold mines at that place, have equipped their mines, offices, houses, etc., with electric light and power. They have placed their order with the Royal Electric Company for a 40-k.w., S.K.C., twophase generator with the necessary transformers and supplies. They purpose furnishing light to their employees.

In the advertisement of the Toronto Electric Works Co., last month, the compositor made the company announce box bells of size 4½-inches at 30 cents. The size should have been 2½ inches. The former size would have been a gift; but a good pivoted iron box bell, 2½ inches, at 30 cents is just a bargain —and that is what the firm were announcing.

The tender of the Telegraph Construction and Maintenance Company to lay a cable from Vancouver, B.C., to Queensland and New Zealand, via Fanning Island, the Fiji Islands and Norfolk Island has been accepted by the committee acting for the British and Australian governments. It is estimated that the cable will cost £1,795,000. The line will be completed by the end of 1902.

The Sarnia Street Railway Company has placed the orders for the cars for the new electric railway system. The bodies of the cars will be built by the Ottawa Car Company, of Ottawa, and will be of the most modern type. The company has also placed an order with the Taylor Truck Company, of Troy, New York, for four car trucks. Orders have also been placed for the overhead equipment, which is to be furnished by the Ohio Brass Company, of Mansfield, Ohio. It is expected that the electric system will be in running order this month.

The Cataract Power Company at DeCew Falls have just completed the installation in their power house of one of the largest electric generators for light and power purposes, built in Canada, and, we understand, by weight, the largest in North America. The generator has a capacity of 2,000 k.w. with a large overload capacity. The weight of this generator complete, is over 110 tons, or 220,000 pounds, and is similar in design to the 1,000-k.w. machine, two of which the Cataract Power Co. now have in their station. There was also shipped from the shops of the Royal Electric Co., Montreal, last week, the second of these large generators, making the capacity of the Cataract Power Co.'s plant, when this generator is installed, over 10,000 h.p. The entire machinery throughout has been supplied by the Royal Electric Co., Montreal, and consists entirely of S.K.C. apparatus operating at two and three phase. This is now one of the most complete power stations in Canada, and is giving excellent results. The two lines from DeCew Falls to Hamilton, a distance of 35 miles, are now in daily successful operation.

James Ross, vice president of the Montreal Street Railway, who has returned from England, gives The Star some items of interest from across the water. It will be remembered that he and other Canadian capitalists became interested in the Birmingham tramways about seven years ago. For years his company has been trying to get that municipality to allow them to introduce an electric trolley system. It was only a few months ago that this permission was secured. The first part of their new electric line will be opened about the first of the year. Electric trams elsewhere in Great Britain, Mr. Ross says, are gradually adopting the electric tramway system, though many of the most congested districts of London are not at all adapted to such an electric tramways. The new underground electric railway in London, known as the London Central, is an unqualified success under the management of G. C. Cunningham, late manager of the Montreal street railway. The new line was opened some time ago, and is now carrying over 100,000 passengers a day. Its construction has greatly relieved the congestion on Oxford street. The trams are drawn by an electric locomotive and are made up of seven cars each. The tunnel is ten feet six inches in diameter, and is some sixty feet below the surface of Oxford street. The regular fare charged was twopence, though at certain hours in the morning and evening workingmen were carried at a reduced fare.

Railway Matters.

Rogers & Taylor, Montreal, are working on the contract for double tracking the Grand Trunk from Hamilton to Niagara Falls. The work will cost about $500,000.

The St. Mary's River Ry. from Lethbridge to Sterling and Spring Coulee, N.W.T., parallel with the irrigation canal, was opened for traffic last month. It is a colonization road.

The Canadian Pacific Railway will build at its shops, Perth, Ont., 138 box cars, 100 hopper bottom gondolas, 20 refrigerators, and 100 ore cars for the Kootenay district. The cars are to be of 60,000 pounds capacity.

Foley Bros., contractors, St. Paul, Minn., are engaged on the construction of 120 miles of the Algoma Central Railway, which will carry it from its present terminus to the new iron mining region near Michipicoten.

It is reported that the new Ottawa and New York railway will be absorbed by the New York Central, which will thus have a direct road from the commercial capital of the United States to the political capital of Canada.

The Magnetawan River Railway Company are asking the Legislature for a bonus of $15,000, to aid in the construction of their road from the main line of the Grand Trunk, at Burk's Falls, to the head of navigation on Magnetawan river.

W. C. Morris, Republic, Wash., is negotiating for the right-of-way for a new railroad, under the name of the Kettle River Line, to connect with the international boundary with a 4½ mile spur, which the Canadian Pacific will build from Grand Forks, B.C.

The Rutland and Vermont Ry., which recently bought the East Richelieu and United Counties lines (now known as the Quebec Southern), intend to build an elevator at Sorel, hoping to draw a good deal of freight from the West to ship at Sorel for the sea.

The Orford Mountain Railway is being rapidly extended from Kingsbury, Que., in the direction of Richmond and Windsor Mills. It starts at Eastman, on the Canadian Pacific, to connect that system with the Grand Trunk. A branch of the road is also being extended from the main line between Eastman and Laurenceville and passes the north side of the head of Manilla Lake. It is also understood that the railway purposes securing a connection with the Central Vermont at Waterloo.

Mining Matters.

The Dominion Iron and Steel Co., Sydney, C.B., have at present about 1,000 men working in their mine at Belle Island, Newfoundland.

The Winnipeg Mining and Smelting Co. has been reorganized, and will now be known as the Winnipeg Mines, Ltd. The company will have a capital of $1,250,000.

The Ascot mine, near Sherbrooke, Que., is about to be started up again. New machinery is being placed in it, and the mine will be operated by a syndicate of capitalists under the management of John McCaw.

The Carscallen copper mine, of Flinton, Ont., has been purchased by the Gooderhams, of Toronto, for $1,500 cash. They have sunk a shaft 25 feet deep by 8 feet square. The ore is said to be found in abundance, and of first class quality.

The Crow's Nest Pass Coal Co. has ordered a 350-h.p. engine from the Robb Engineering Company for its mines at Fernie, British Columbia.

The Nova Scotia Steel Co. intend opening new shafts at Point Aconi, C.B., to increase the annual output of the old G.M.A. mine to 750,000 tons.

A valuable deposit of coal has been discovered near Harbour au Bouche, C.B. If the surveys prove favorable, the Government will supply machines for prospecting purposes.

Silver and copper have been discovered near Mink Cove, Digby County, N.S., and the property secured by Balfour Brown, Yarmouth, and Israel Burrill, Weymouth, N.S.

As soon as new furnaces can be built, the plant of the Granby smelter, Grand Forks, B.C., will be increased to 1,200 tons daily capacity, the present capacity being 500 tons per day.

The Globe Mining Company, Ltd., has acquired the property of the Leviathan Gold Mining Co., on Kootenay lake, opposite Kaslo, B.C. The new company is capitalized at $1,000,000 and assumes the liabilities of the old one.

Daniel O'Connor, Sudbury, Ont., has recently discovered a large ledge of iron ore near the southern extension of Lake Temagami, in Nipissing district. Further information concerning this find indicates that the body is a large one. On the surface, the magnetite is banded with jasper. The metallic contents of the ore are somewhat low, but assays show that the ore is free from deleterious ingredients.

The Ontario Government has issued a license to a corporation, known as the Anglo-Canadian Gold Estates, Ltd., to explore certain large blocks of territory in the Rainy River district for minerals. A large staff of prospectors, etc., has been engaged, the pay roll amounting to $8,000 a month. The manager is Alan Sullivan, C.E., son of the late Bishop Sullivan. The license is for three years, dating from January, 1900, in which time the company is required to spend $120,000 in exploring and developing the land licensed.

In the opinion of Thos. Cantley, of the Nova Scotia Steel Co., the chromic iron deposits of Newfoundland, which the company is now using, are among the finest in the world. Mr. Cantley says it is only a question of time when the iron ore of Ontario will be shipped to Nova Scotia. This will depend on the enlargement of the St. Lawrence canals, as the largest cargo of Ontario ore that can now be delivered at New Glasgow is two thousand tons. The cargo his company would desire would be one of six thousand tons. To handle such cargoes the locks of Ontario's canal system should be increased to five hundred feet in length, and to eighteen or twenty feet in depth. This accomplished, the transportation of iron ore from the Upper Lakes to the coal regions of Nova Scotia would be placed on a permanent and profitable basis.

One of the valuable assets of the Similkameen, B. C., country is its enormous deposits of coal. Starting at Princeton the coal seams owned by the Vermillion Forks Co. are within a stone's throw of the town. Development shows about eight feet wide of solid clean coal. Traveling up the Similkameen river for 10 miles, strong croppings are met with on either bank. The same showings are found on the Tulameen. George De Wolfe, F.G.S., of Vancouver, having made an examination claims there is enough coal in sight to warrant the early construction of a railroad to the district, even if the coal was the only inducement offering. Several coking tests are now being made from samples taken from different properties. From an analysis of several samples the coal has been found to contain from 54 to 72 per cent. carbon. The coal fields of Similkameen, he claims, will yet rival those of the Crow's Nest Pass.

It is stated that M. A. Hanna & Co. have arranged with F. H. Clergue, of Sault Ste. Marie, to handle in the United States ore from the mines at Michipicoten. A cargo of 2,456 gross tons of the ore was delivered at Ashtabula a few days ago by the steamer "Iroquois," and will be smelted during the winter at one of the furnaces in which Hanna & Co. are interested. It is thought that the ore, which is said to be similar to the best hard ores mined by the Minnesota Iron Co. on the Vermillion range, will prove high enough in quality to warrant the payment of 40 cents a ton duty necessary to admit it to the United States.

The Bethlehem Steel Co., of Pennsylvania, will make a trial of 200 tons of iron from the Robertsville iron mine on the K. & P., owned by Ferguson & Folger, of Kingston. If the trial is satisfactory regular shipments will be made. This is an old mine that has been closed for over 15 years.

The directors of the Dominion Steel Co. held a meeting in Montreal on Nov. 28th to consider the company's plant at Sydney, C.B. A. J. Moxam, general manager, stated that 100 coke ovens and two blast furnaces were now ready, and that the manufacture of iron would shortly be commenced. The company intend to begin the manufacture of steel next summer.

A Chamber of Mines for Southern British Columbia has just been established at Rossland, B.C. J. B. McArthur was elected president of the organization. The intention is to familiarize investors with the various portions of the mining district, and give accurate information regarding developments in that district.

The only large dredge on the Saskatchewan for gold dredging purposes, is the "Otter," which has been equipped with new machinery from England, but not in time to do any real work this season. This is owned by the Drolet Co., who are also building at Edmonton two other large dredges to be fitted up with strong machinery from England. These are of the type so successfully used on the rivers of New Zealand, and are to be ready for operations next spring.

Evan and Chas. Thompson, Sydney, C.B., owners of the Colonial gold mine at Renfrew, N.S., are the possessors of a gold brick weighing 2,700 ounces and valued at $54,000. It is the largest brick of gold ever found in Nova Scotia, and it came from 110 tons of quartz. To secure it the owners spent $1,800, giving them a margin of $52,000. During the past three months this mine has yielded $70,000 in gold from an expenditure of $3,000, and with less than a score of men working. The property consists of 300 acres and only a small corner has been worked. Its prospective yield is estimated in the millions, and the mine will be fully developed at once.

The exploring parties sent out in the autumn into Northern Ontario by the provincial government have now all returned. Such a cursory examination as the explorers would be able to make of minerals would not, of course, determine the mineral resources of the new country, but a number of more or less important finds were made; while the reports on the agricultural and timber lands are most encouraging. Pulp timber exists in almost exhaustless quantities, while there are vast tracts of fine farm land awaiting settlement in a climate that is more temperate than one would suppose from the latitude. We understand these reports are to be published shortly in book form for general information.

O. R. Sprague, a Buffalo mining expert, has reported that on the property of the Cobb Mining and Developing Company, on Dog Lake, Frontenac county, Ont., about 400,000 tons of emery are now in sight. It is said that actual tests show this to equal the finest Turkish emery. The company will draw this winter 500 tons into Kingston, and ship to Buffalo, where the material will be manufactured into emery wheels. The directors of the company contemplate erecting a mill upon its site at Dog Lake next year, to supply the European and Canadian trade. The emery is valued at $90 per ton, crushed, wholesale. There is evidence also of molybdenite in unlimited quantities. This is used in the manufacturing of armor plates, superseding nickel and steel, and has a market value of $550 per ton. On the galena vein there is a shaft sunk 30 feet deep, and a 25-ton smelter will be erected soon.

The following is the substance of a statement given to the press regarding the effect of the Ontario Government's recent legislation on nickel refining: The Orford Copper Company, which has been for years refining, at its works in New Jersey, the copper nickel matte of the Canadian Copper Company, are now establishing a smelting or refining works at Copper Cliff, a few miles west of Sudbury, in the vicinity of the Canadian Copper Company's McArthur mine. It is expected the refinery will be completed about the end of this year. S. C. Lake is in charge. The plant consists of a 75-h.p. engine, two 125-h.p. boilers, a dynamo, a Cameron pump, a Krupp ball mill a Blake crusher, Brown straight line calcining furnace with a 70-foot stack, and two cupola smelting furnaces. The

object is to calcine and smelt the copper-nickel mattes at present produced by the Canadian Copper Company with a view of raising the metallic contents of the matte to about 80 per cent., thus making it a high grade matte, instead of low grade, as at present. It is also proposed to treat the basic copper matte after smelting the ore from the Orford Company's mine near Massey Station in the same plant, using as a flux with these ores the somewhat cupriferous silicious slags from the reconcentration of the Canadian Copper Company's matte. The works will be capable of treating about double the present matte output of the Canadian Copper Company, and will employ about 150 men. The copper vein in Salter township, near Massey Station, which the Orford Company is working, is about a mile in length, and varies from four to eight feet in width. The ore is chalcopyrite. The company proposes to raise 200 tons of ore per day, about one-half of which will be sent direct to the smelter, which the company will erect at Massey Station, and the other 100 tons will be concentrated to a product containing about 15 per cent. copper.

Marine News.

The Allan Line is adding four new steamships to its fleet. The first boat will be ready in January, and will be called the "Pretorian."

On Nov. 22nd the steamer "Fife," owned by R. G. Reid, St. John's, Nfld., ran ashore in the Straits of Belle Isle. She was worth $100,000, and is a total loss.

The first steamer carrying grain direct from the American West, via G.N.R., from Quebec, shipped her cargo last month, and the new elevator at Quebec in connection with the same railway was inaugurated on Nov. 24th.

The Great Northern Railway has made a contract with the Leyland Line, whereby they charter five boats of that line for five years to carry grain between Quebec and England. This will enable the Great Northern to run a weekly service.

The Marine Court in the enquiry into the loss of the government steamer "Newfield," gave a decision on Nov. 15th. Capt. Campbell's certificate was suspended for six months; Chief Officer Blackeney was severely censured and his certificate was suspended for three months; Second Officer Callaghan's certificate was suspended one month.

The steamer "St. Olaf," which has been running for several years between Quebec and the ports on the north shore of the St. Lawrence, was wrecked at Boule Island on the evening of Nov. 21st, and about 26 lives were lost. She was a well-equipped steamer of over 300 tons, and was commanded by Capt. P. T. Lemaisfre. The "St. Olaf" was valued at over $40,000, and was insured for about half her value.

The propeller "Persia" of the Toronto & Montreal Steamboat Co., was almost wholly destroyed by fire on Nov. 27th The boat was built at St. Catharines 21 years ago, and was valued at $18,000, carrying $10,000 insurance. The principal owners of the vessel were James Carruthers, W. A. Geddes, Capt. Scott and J. T. Mathews. At time of going to press it had not been decided whether the vessel will be rebuilt.

A terrible disaster occurred off Yarmouth on Nov. 10th, when the Yarmouth Steamship Co.'s steamer, the "City of Monticello," was foundered en route from St. John to Yarmouth. The passengers and crew numbered 39, and all except four were lost. The vessel was a side-wheeler of 1,034 tons, and was purchased by the Yarmouth Steamship Co. last year for $30,000. She was built 36 years ago at Wilmington, and rebuilt 20 years later at New York, and was insured for $25,000.

Bradford Cann, Yarmouth, N.S., has recently placed an order for a freight steamer of about 5,800 tons carrying capacity, with Russell & Co., New Glasgow, Scotland, to be delivered in April of next year. The boat will be about 340 feet long, fitted with all modern appliances for the quick handling of freight. She will have one funnel and two telescoping steel masts, and will thus be able to pass up the Manchester ship canal. She will be fitted with triple expansion engines with high, intermediate and low pressure cylinders 24, 40, and 65 inches in diameter, respectively, and 45 inch stroke, capable of driving her at the usual economical speed of such vessels, about ten knots. Capt. George B. Cann will command her. She will be owned by a limited liability company bearing the steamer's name, which has not yet been decided upon.

The Richelieu & Ontario Navigation Co. have closed what may be called a record season, both financially and as to the number of passengers carried, and freedom from accidents. Mr. Gildersleeve's good judgment and able management seems likely to accomplish for the R. & O. Co. what that of Mr. Hays has done for the Grand Trunk. The company has decided to put on the Lake Ontario route another new steamer after the type of the Fall River boats, with modern improvements. The new steamer, for which the contract has been given to the Bertram Engine Works, of Toronto, is to be 340 feet long—that is, 62 feet longer than the new steamer "Toronto," and 50 feet longer than the steamers "Kingston" and "Quebec." The width will be 42 feet in hull and 73 feet over the guards. The depth of hull, 15 feet. The name of this new steamer is not definitely decided, but it will in all probability be called the "Montreal;" the present boat of that name to be renamed. There will be over 266 staterooms, including 22 parlor rooms and 8 bathrooms. The contract calls for a style of finish unsurpassed by anything afloat. The saloon will be built with two tiers of staterooms, and so arranged that a third tier can be added subsequently, which would give one-half more sleeping accommodation. The dining room will be on main deck aft. There will be accommodation for second-class passengers on main deck forward, which will have a large number of sleeping berths. The engine to be inclined triple expansion with three cylinders and three cranks of three thousand horse-power, with feathering paddle wheels and curved steel buckets. The steam to be from 175 to 200 lbs. pressure, and the consumption of coal not to exceed 1.68 lbs. of coal per indicated horse-power per hour. There will be six single ended Scotch boilers; each 11 feet diameter and 11 feet 6 inches long, with howden hot draft. They will discharge into the smokestacks, and will be placed down the centre of the hull with the front ends facing each other, and the back side next the sides of the hull. The regular service speed is to be 17 miles per hour, with ability to make 19 miles when required. The engine is of the same style as that of the steamer "Toronto," but will have half more power than the "Toronto's" engine, and a speed of three more miles an hour than that of the present Quebec steamers—one of which this new steamer is to replace—and will have double their capacity for freight carrying. Contract calls for completion of boat in the spring of 1902. Next season the new steamer "Kingston," with the "Toronto," will form the line between Toronto and Prescott, and the steamers "Bohemian" and "Columbian" will receive the passengers at Prescott, and bring them to Montreal. The "Columbian" is now being prepared with completely new upper saloon, dining-room and all other necessary rearrangement for that service. The Quebec and Saguenay line will be the same as in past season, but the following year (1902) when the new "Montreal" is on the Montreal and Quebec route, the present steamer "Montreal" will be changed into a pilgrimage boat, with complete new passenger accommodation, giving her a passenger capacity double that of the present pilgrimage steamer "Three Rivers." The Hamilton line is to be still further improved the coming year, the "Spartan" running with the "Hamilton" and "Algerian," thus giving a direct tri-weekly service between Montreal and Hamilton, and being one steamer more than in past season.

Duncan McDonald, for many years superintendent of the Montreal Street Railway, has been offered, and accepted, the superintendency of the General Traction Co., Paris, France. This company has a capital of 30,000,000 francs, and controls minor companies with a total capital of nearly the same amount. The parent company has organized interests in Switzerland, Belgium, Egypt and other countries, and Mr. McDonald will be an advisor to these boards also. As a Canadian, who has worked himself up to his present position he is to be congratulated on his appointment to such an important post. His successor is M. J. Kennedy, assistant superintendent.

Personal.

A. R. Davis, C.E., formerly of Wabigoon, Ont., is now in the employ of the C.P.R. at Winnipeg, Man.

T. H. Dunn, Morrisburg, Ont., who has been for several years engaged in civil engineering, will shortly leave for California.

A. F. Bury Austin, the well-known lumber merchant, Montreal, has gone to British Columbia on an extended business trip.

George Wilson, contractor and manager of the Sovereign Gold Mining Co., died at the General Hospital, Kingston, Ont., on Nov. 16th, from acute inflammation.

C. A. Chesterton, Rat Portage, Ont., is taking the agencies of the Jenckes Machine Co. and the Rand Drill Co., at that place. These were formerly held by R. W. Smith.

We hear from Quebec of the sad bereavement of Mr. Ulric Barthe, secretary-treasurer of the Quebec Bridge Company, who has within one week lost his mother and his wife.

Harold J. Bell, a former resident of Montreal, and the inventor, among other things, of the burner commonly known as the Welsbach burner, died last month at Denver, Col., at the age of 41.

H. Foster Chaffee, well-known as the Montreal agent of the R. & O. Nav. Co., and who has been with the company for fourteen years, has been appointed western passenger agent of the company at Toronto.

W. S. Cranston, C.E., has been appointed assistant engineer of Ottawa, at a salary of $1,500 per annum. Mr. Cranston has for some time been engaged under Robt. Surtees, C.E., on waterworks and sewerage construction in Arnprior.

A. A. Wright, president and managing director of the Renfrew Electric Co., has had many congratulations on his election as member of the House of Commons. Mr. Wright is the only man in the Dominion House representing the electrical interests, but as electric light men consider him quite a battalion in himself they will no doubt feel well represented.

Rev. P. J. O'Brien, St. John's, Newfoundland, has recently visited Ald. Frank E. Walker, of Hamilton, Ont. Father O'Brien is a student of naval architecture, and brought with him a number of models for demonstrating his recent patent for increasing the stability, speed and seaworthiness of vessels. Boats containing these principles have been built on the eastern coasts and have proved highly successful.

Emile Doucet, C.E., has been appointed chief engineer of the Great Northern and Quebec & Lake St. John railways. Mr. Doucet has had experience in both military and railway operations, having acted as aide de camp to General Sir Fred. Middleton during the Northwest campaign. He was seriously wounded at Fish Creek. He has been engaged as civil engineer on railway and bridge works for a number of years.

James A. Moore, brother of W. H. Moore, solicitor, Toronto, has returned from a trip to the Yukon. He reports that the journey to our great "North Land" can now be made with as much comfort as a trip to the Maritime Provinces, and that the development of the resources of the country has now taken on a permanent character. Quartz mining will now follow alluvial gold digging, and copper mining will soon be an important industry. The coal so far discovered is very soft and tarry in burning, but better veins are looked for below the surface.

Owing to a difference of professional opinion between himself and the chief engineer of the Department of Railways and Canals, W. G. McN. Thompson, chief engineer of the Welland Canal, has resigned, and is succeeded by J. L. Weller, for 12 years resident engineer of the St. Lawrence canals at Cornwall, and recently in charge of the Port Colborne harbor improvements. Mr. Thompson, who is an engineer of high standing and a past president of the Canadian Society of Civil Engineers, has decided to go into private practice in his profession, and has already opened an office in St. Catharines.

At a meeting of the Montreal city council the other day the resignation of P. W. St. George from the position of city surveyor was accepted, and the temporary appointment of George Janin as superintendent of the Montreal waterworks was confirmed. Mr. St. George's successor has not yet been decided on. In a letter to the mayor Mr. St. George states that his resignation was forced on him by the unfair treatment of the road committee, and the unwarrantable interference with his functions as city surveyor. The Witness says he "has been hated by some because he refused to subordinate his personal convictions of duty and his professional reputation to the huckstering of contracts and of departmental appointments."

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the exports of metals, etc., from Great Britain to Canada for Oct. and the ten months ending Oct. of this and last year :—

	Month of Oct.		Ten months ending Oct.	
	1899	1900.	1899.	1900.
Cutlery	£4,043	£3,951	£43,347	£50,488
Hardware	1,848	2,878	17,036	23,378
Pig iron	11,385	3,734	25,992	40,605
Bar, etc.	7,977	276	22,234	13,300
Railroad	38,979	22,341	152,881	71,089
Hoops, sheets, etc.	8,449	6,069	92,959	66,931
Galvanized sheets	8,520	5,137	57,589	48,112
Tin plates	46,925	63,589	188,585	259,260
Cast, wrought, &c., iron	10,500	1,735	50,250	34,681
Old (for remanufacture)	883	....	5,073	9,559
Steel	40,663	3,104	110,340	131,674
Lead	7,691	3,727	41,788	21,926
Tin, unwrought	1,130	3,142	19,563	35,605
Cement	7,894	5,118	30,537	56,586

Among the imports from Canada to Great Britain for the same periods are the following :—

Copper Ore	....	....	200	123
Pulp of Wood	3,675	25,385	121,214	185,389
Wood—Hewn	49,125	102,823	499,588	551,775
" Sawn	421,193	675,321	3,640,651	3,988,806

IMPERIAL TRADE NOTES.

The following are among recent enquiries relating to Canadian trade received at the High Commissioner's Office in London. Addresses of the firms can be given on application at this office:

A commission agent in Scotland is open to represent Canadian firms manufacturing household woodware, hardware, etc. A Belgian (Antwerp) firm asks for names of exporters in St. John, Halifax, or elsewhere, of seal oil. Another Antwerp house desires to correspond with Canadian exporters of lard, grease and oils. Enquiry is made by a Manchester firm, concerning the opening for trade in hard and soft felt hats in Canada, and for suitable agents to take up these lines. A manufacturers' agent in Glasgow would be glad to hear of Canadian firms in the furniture trade, who require an agent with a good connection among cabinet-makers, ironmongers, etc. An enquiry has been received respecting Canadian asbestos, and the companies engaged in working it. Communications are desired by a firm in the Midlands, from the actual producers in Canada of crude asbestos. A Vancouver, B.C., house asks for a list of prominent English paper manufacturers, and parties interested in wood-pulp.

NEW CATALOGUES.

"2,500 Witnesses" is the suggestive title of a 56-page production of the advertising department of the B. F. Sturtevant Co., Boston, Mass. Being as announced in the sub-title, "A List of Buildings and Sundry Steamships wherein the Sturtevant System of Apparatus has been installed for the Purposes of Ventilation and Heating." The introduction contains this statement: "Some evidence is usually demanded by the prospective purchaser as to the extent and success of the application of the article or system under consideration. Printed testimonials, no matter what their tenor, are always more or less questionable as to their character. But a comprehensive

list of purchasers and users, to each and every one of whom the enquirer is at perfect liberty to apply for information, forcibly presents, by its very numbers, the most indisputable evidence of widespread adoption, and provides the best possible opportunity for searching enquiry as to success."

MECHANICAL REFRIGERATION.

Read by F. H. White, B. A. Sc.

With the kind permission of those members of the committee of your society who have done me the honor of asking me to read a paper before you I will endeavor this evening to give you an outline of what is meant by Mechanical Refrigeration, with some of its commercial uses and notes on its development. For those who care to go into the thermo-dynamic theory of the production of cold, I cannot do better than recommend them to read the Howard lectures on Mechanical Production of Cold, delivered before the Society of Arts, London, Eng., by Prof. J. A. Ewing, M.A., F.R.S., M.I.C.E., during the winter of 1897. These lectures are published in pamphlet form by the Society of Arts, and have lately been republished in series, in Ice and Refrigeration, which is a journal published in Chicago, devoted to ice-making and kindred trades. I am indebted to these lectures for the greater part of the facts brought out in this paper.

Refrigerating machines have been developed entirely on scientific principles, and are the result of careful research and experiment, and to a great extent the outcome of theoretical knowledge, in this they differ largely from the steam engine, which in its early stages owed little or nothing to theory. The first form of refrigerating machine to be used extensively was what is known as the air machine. The first form of this of which we find any record was invented by Dr. Gorrie in 1845. Dr. Gorrie's machine was intended for ice-making. It consisted of a compression cylinder in which the air was compressed and from which it passed to a cooling chamber surrounded by H_2O. This chamber was kept at a pressure of about 15 lbs. per square inch. The air was also cooled by injecting cold water into the compression cylinder. From the cooling chamber the air was allowed to expand into another chamber at about atmospheric pressure. Into this expansion chamber brine was injected. The temperature of the air being reduced by expansion, this low temperature was communicated directly to the brine. The air was allowed to escape to the atmosphere, while the brine at about 20° F. was drawn off to a tank, to be used for ice-making and refrigerating. This machine was not a very great success, and Prof. Siemens, who made a thorough test of it in 1857, pointed out that a great part of the cold produced was lost by allowing the air to escape from the expansion chamber while still at a low temperature. One of Siemens' suggestions to remedy this was what became known as the interchanger. By this the air escaping from the expansion chamber was sent through a series of pipes, outside of which the air going to the compressor should pass. This interchanger of Siemens' is the earliest example of what is known as the regenerative principle of producing cold. I may mention here that it is by this regenerative principle that Dr. Linde was first enabled to liquefy air in large quantities, and in fact, this principle is used in the liquefaction of all gases which require very low temperature in the process. Among other early machines we find one which was built by Dr. Alexander Kirk in 1862. His machine was a closed cycle machine, and was in reality the Stirling engine reversed, that is working as a heat pump instead of as a heat engine. Kirk began by making a small model with a cylinder 3 inches in diameter, and with this was enabled to freeze mercury. Kirk afterwards built several large machines, one of which was used at Bathgate, England, for extracting parafine from parafine oil; another was used for ice-making in Hong-Kong. This latter is said to have made 4 lbs. of ice per lb. of coal, equaling an efficiency of about 10 per cent. This style of machine was never a great success, and is now obsolete, as, indeed, are all forms of closed cycle air machines.

Two other inventors whose names are associated with closed cycle air machines were Allen, an American, and Windhausen, a German, who has been a pioneer in several lines of invention relating to the mechanical production of cold.

The next type of machine to come into notice was the open cycle air machine, a type which has had a far more important application. This machine was foreshadowed by Lord Kelvin in 1852, also by Rankine about the same time. It was first applied practically for refrigeration by Gifford in 1873, and was afterwards modified by a number of inventors, mainly English, in whose hands it attained great practical success.

In 1877 Lord Kelvin was consulted by Messrs. Bell as to the best means of mechanically refrigerating meat during its transport over the sea. Lord Kelvin drew the attention of Mr. Coleman to this matter, and Mr. Coleman devised a form of refrigerating machine, which afterwards became known as the Bell-Coleman refrigerating machine. This was essentially similar in general principles to Giffard's machine of 1873. Almost immediately after this the subject was taken up by Mr. Lightfoot, who developed a Giffard machine, improving it in mechanical details, and introducing new features. Another maker of this class of machine was Mr. Haslan, who later took over the manufacture of the Bell-Coleman machine, and who has probably turned out a larger number of air machines than any other engineer. One of the Elder-Dempster boats which was sailing to this port last season had one of Haslan's machines in operation; and the engineer-in-charge said that it worked very well as far as getting low temperatures was concerned, but it used up too much coal to be economical. Messrs. Hall, of Dartford, are also among those who contributed to the extensive use of air-machines. In 1878 the steamer "Stratleven" was fitted with one of these machines, and made an experimental voyage to Australia, taking a small cargo of frozen beef and mutton home to England, and thus inaugurating a trade which has grown to enormous proportions. In 1896 there were imported to England about 5,750,000 carcases of mutton from Australia and New Zealand. Since then a large number of eggs and large quantities of butter are annually imported, besides other produce. When we consider that in 1880 there were only 400 carcases of mutton imported from Australia we see at once the great value of mechanical refrigeration, as applied to shipping. All these air machines consist essentially of the following parts:

Two working cylinders—a compressing cylinder and an expanding cylinder.

The air is taken in by the compression cylinder from the room that is to be cooled; it is then compressed and thereby warmed; it is then cooled, by circulating H_2O, while in a compressed state; it is then expanded to atmospheric pressure in the expansion cylinder, and thus made very cold, and returned to the cold room, from which it came. The great difficulty in operating these machines is the constant formation of snow in the expansion cylinder and discharge chutes, due to the moisture in the air when taken from the storage rooms.

Many methods were devised by inventors to get rid of this moisture. The most successful methods were those devised by Mr. Lightfoot, and Messrs. Haslan, in the Bell-Coleman machine. Mr. Lightfoot made his expansion compound; in the first expansion the temperature was reduced to about 32° F., so that no snow was formed, but water was deposited which could be drained off. Haslan's method was to pass the air over drying pipes which were kept at about 32° F. by a current of cold air through them, so as much of the moisture as possible was deposited as H_2O before the air was expanded. There are still a good number of air machines used on board ships, but on account of their relatively large consumption of power, and also their low efficiency, if used for other purposes than for cooling the air of a room, they have been almost entirely displaced by machines using a liquid, and its vapor as an agent—such as ammonia or carbonic acid.

I will now say a few words about what are known as absorption machines. In any machines of this type there are two substances used which have an affinity for one another. By the direct application of heat these substances are separated from a state of union with one another. One of these is a vapor, and as it separates it is condensed at a relatively high pressure, giving up its latent heat to circulating water. Then the condensed vapor is allowed to re-evaporate, and is absorbed by the other substance as it does so. During this process the other sub-

stance is kept cool, consequently re-evaporation and absorption of the vapor go on at a relatively low pressure; this low pressure is associated in the vapor with low temperature. While the vapor is re-evaporating it takes up heat from bodies around it, and is effective for refrigeration. This completes the cycle, and the substance may again be separated by the agency of high temperature, heat, etc. No mechanical work need be spent in this process, and machines of this class have no co-efficient of performance in the sense in which that term is generally used. Of practical machines working in this general way there are two kinds. In one kind the vapor used is water, and it is absorbed by sulphuric acid. In the other kind the vapor is ammonia, and is absorbed by water.

Water Vapor Absorption Machines.—When H_2O vapor is used to effect refrigeration, the pressure at which the vapor is formed, which is the pressure due to the lower extreme of temperature, must be very low, and hence the machines using water and sulphuric acid are often described as vacuum machines. The method of cooling by evaporating H_2O in vacuo, and using sulphuric acid to absorb the vapor, was known almost from the beginning of the century. Prof. Leslie in the year 1810, or thereabouts, described a laboratory experiment in which H_2O was frozen by placing it in a saucer under the receiver of an air pump from which the air had been exhausted, while there was under the same receiver another saucer containing sulphuric acid. After the air had been exhausted the vapor of H_2O was given off freely, and was absorbed by the sulphuric acid, owing to its great affinity for H_2O. The vapor obtained its latent heat by drawing upon the stock of heat which the H_2O contained, and the consequence was by the time a certain portion of the H_2O was evaporated it was so chilled as to convert it into ice. That type of machine is essentially one of the absorption type, because the active feature in it is the absorption of H_2O vapor by sulphuric acid. The pump which produces and maintains the vacuum is an accessory, and not an essential of the machine. In practice the pump is required because there is atmospheric air which has to be got rid of in the first place, in order to let the water vapor come into free contact with the sulphuric acid. When once the air is got rid of the pump might stop acting, and the performance of the machine would continue were it not for the fact that in practice there is always a certain amount of air mixed with H_2O in solution, which continues to be given off by the H_2O, and requires the action of the pump to be kept up. If we wish to convert such a machine into a continuously working one, with a complete cycle of operations, we must separate the water from the sulphuric acid in which it has been absorbed. This can be done by the agency of heat. Such a machine was, in fact, made in 1878 by Windhausen, and was practically employed, on a somewhat larger scale, by the "Aylesbury Dairy Company" in the making of ice. It was described before the Society of Arts in 1882 by Dr. John Hopkinson. There a complete cycle of operations was used. The water to be frozen was chilled by causing a portion of it to evaporate, and be absorbed by sulphuric acid. The sulphuric acid thus diluted was passed into a vessel called the concentrator where heat was applied to drive off the water, leaving strong acid ready to be used over again.

Ammonia Absorption Machines.—The other class of refrigerating absorption machine which uses ammonia dissolved in water, is in much wider use than the sulphuric or "vacuum" machine. Its action is in general respects the same, but as ammonia has a much higher vapor pressure than H_2O, there is no vacuum, but pressure higher than that of the atmosphere throughout. The ammonia absorption machine was invented by F. Carré about the year 1860. At first it was very crude, consisting merely of two vessels, in one of which was placed a strong solution of ammonia in H_2O; the other in the first instance was empty, and was surrounded by cold water. The vessel containing the solution of ammonia was heated, and the gas passing over under pressure into the other vessel, where it was condensed, giving up its latent heat to the water outside. A little steam passed over with it, but the main constituent of what collected in the cold vessel was liquid anhydrous ammonia. The solution of ammonia in the first vessel became more and more dilute. After this had gone on for some time, the source of heat was removed, and the vessel containing dilute solution was surrounded by cold H_2O. The condensed ammonia in the other vessel then evaporated, being re-absorbed by the dilute solution. In re-evaporating, the ammonia exerted a refrigerating effect. By making the condenser with a hollow central space, in which a can of H_2O was inserted, the re-evaporation of the ammonia was caused to freeze the contents of the can. The action of this small machine of Carré's was intermittent. It required that the vessel containing the ammonia solution should be alternately applied to the source of heat, and placed in cold water. Each of the two vessels discharged two separate functions; one vessel served in the first instance as a condenser of anhydrous ammonia, then in the second instance it served as the refrigerator. Again, the other vessel served in the first instance as the generator of the anhydrous ammonia, and then in the second stage of the process it served as the absorber. Suppose, however, that we had four vessels instead of two, each of the four discharging one function, and that we have a pump by which the liquid, which has been in the absorber and has got the ammonia restored to it, shall be pumped back into the generator. In that case we have the continuous machine, which was soon developed out of Carré's primitive apparatus. Mr. Reece, Mr. Stanley, Mr. Mart and others adding features which are found in the ammonia absorption machine of the present day. I pass on to speak now about the process of refrigeration which is now by far the most important process of all.

The Vapor Compression Process.

Air machines and ammonia absorption machines find a limited amount of use, but the great bulk of work of refrigeration is done by machines which act by the mechanical compression of a condensible vapor. The other types of machines possess great scientific and historical interest, but in point of commercial importance they take a very secondary place. The vapor compression process is the most efficient of all. It allows a co-efficient of performance to be reached in practice which makes a very respectable approach to the thermo-dynamic ideal. All vapor compression machines consist of four principal parts, viz.: The compressing cylinder, the condenser, the regulating valve, the refrigerator. In the compressing cylinder the vapor is compressed, and thereby heated; in the condenser the heat of compression is taken out and the vapor is reduced below its critical temperature and thus liquefied. From here it passes through the regulating valve, and is re-evaporated in the refrigerator taking up heat from the surrounding bodies and thus reducing the temperature. There are three types of the vapor compression machine: The one using sulphurous acid; the next carbonic acid; the third using ammonia. The sulphurous acid machine was introduced by Monsieur Raoul Pictet in 1875. This machine is well known in France and Switzerland, but not much used elsewhere. In his refrigerating practice Pictet has used for a working substance, a mixture, mainly sulphurous acid, but with an addition of about 3 per cent by volume of carbonic acid.

Ammonia Machines.—The ammonia machine was introduced by Dr. Linde, then a professor at Munich, in the year 1876, and was brought into use in the following year. Its convenient range of pressure and its comparatively small bulk commend it to general acceptance, and, further, it has thermo-dynamic advantage, in giving a cycle which makes a closer approach to the ideal Carnot's cycle than is got with any other substances that are practically used. The design of the Linde has been carried out with conspicuous care, and it owes much of its great success to excellence of mechanical detail. It is double-acting with spring inlet and delivery valves at each end, the valves in the ends of the cylinder are so arranged as to make the clearance space particularly small—something like one-half of one per cent. of the volume swept through by the piston. This secures a nearly complete delivery of the contents of the cylinder at each stroke. An interesting detail about these machines is the construction of the stuffing-box. To prevent escape of the ammonia the device is adopted which used to be called in steam engines a lantern brass. The packing is divided into two parts, with a hollow space in the middle, and the space is in this example connected by a pipe with the suction side of the machine. Hence any ammonia which leaks through the inner part of the packing is carried away to the suction side, and not lost; and the outer part of the packing is exposed to no more pressure than the difference between the pressure on the suction side and that of the atmosphere. Any leakage to the outside depends upon that difference of pressure, and not on the much

larger difference of pressure which exists between the compression side of the machine and the atmosphere. Another point of importance is the lubrication. Oil is forced in through a hollow in the gland, and spreads itself over the surface of the piston-rod. No more oil is used than is required for the lubrication of the piston-rod. In this respect the Linde machine differs from some of the other examples of ammonia machines, in which oil is injected into the cylinder and allowed to mix in considerable quantity with the working vapor. Even here, however, there will be some slight admixture of oil with the ammonia, and as it is desirable to remove the oil before the ammonia is condensed, in order to prevent a deposit, which would interfere with the activity of the condensing surfaces, an oil separator is used in the larger size of the Linde machine. This is an upright vessel, through which the $N H_3$ from the compressor passes, depositing in the bottom any oil that it brings over. The oil is drained into a second vessel below, which is exposed to the suction pressure only, so that most of the $N H_3$ contained in the oil evaporates before the oil is drawn off. The machine and all the parts of the system are made of iron and steel, no brass or copper being permissible. There is no water jacket, for wet compression is used, and the $N H_3$ when it leaves the cylinder is cool. Linde usually makes his compression cylinder horizontal, except in the smallest sizes; the steam cylinder is also horizontal and drives on a crank set at right angles to the crank of the compressor. This form is preferred to the tandem arrangement of steam and compression cylinders; on the ground that it gives more uniform crank effort. With the tandem arrangement the steam pressure is least when the compressor pressure is greatest. In another form of large machine, a compound horizontal steam engine is used along with two parallel compressors, each steam cylinder being set tandem with one compressor cylinder. The success achieved by Dr. Linde may be judged from the fact that his companies in England, on the continent of Europe and in America, have sold over 5,000 machines, varying in capacity from one ton up to several hundred tons of ice per day.

Carbonic Acid Machines.—This type of machine was patented by Roydt in 1881, and by Windhausen in 1886. It may be mentioned that Prof. Linde was one of the first, if not the first, to introduce carbonic acid as a medium for refrigeration. In 1882 he supplied a carbonic acid machine to Krupp's firm at Essex, but he preferred the ammonia on thermo-dynamic and other grounds. The carbonic acid machine is particularly associated with the name of Windhausen. His patents were taken up by Messrs. Hall, of Dartford, who have successfully faced the difficult mechanical problems involved in the cyclical compression without serious loss of a substance which reaches a pressure of over 1,000 lbs. per square inch. They have succeeded in getting a very successful compression, but on account of the high pressure it is very difficult to keep the joints tight, and as carbonic acid is a gas without color or smell it is very difficult to detect a small leak, and much of the CO_2 may be lost before the engineer discovers where it is leaking from.

I will now speak briefly on some of the uses to which mechanical refrigeration is put, and the different systems of distributing the cold from the refrigerator to where it is wanted.

In 1896, according to the Linde Co.'s statement regarding the use to which 2,600 of their machines had been put: out of those 2,600 it appears that 1,406 are employed in breweries, 403 in cooling land stores for meats and provisions, 204 in ships for the purpose of the transport of meat and provisions, 222 are employed in ice-making, 73 in dairies and butter making, 64 in chemical factories, 17 in sugar refining, 15 in candle making and 108 for other purposes, which include chocolate manufacture, glue cooling, rubber cooling, skating rinks, manufacture of dynamite and cordite, manufacture of gelatine films for photography, preservation of the eggs of the silk worm until the mulberry leaves are ripe, and also such special uses as that which is known as the Poetsch process of sinking shafts; this is freezing quick-sand, and thus keeping out the H_2O. In breweries the refrigeration is used in cooling the wort by the Baudelot cooler The wort trickles over the Baudelot cooler, which consists of a series of pipes arranged one above the other, through which cold H_2O is passed. As a rule ten bottom pipes in the Baudelot cooler are of wrought iron, and $N H_3$ vapors are expanding inside them

General Cold Stores.

There are three principal systems in use for the cooling of stores, namely, the direct expansion system, the brine circulating system, and the cold air circulating system.

The Direct Expansion System.—In this system the rooms to be cooled are fitted with pipes, much in the same way as buildings are piped for steam heating in winter. In the best practice these pipes are arranged in bundles under the ceiling of the room to be cooled, as the warmest air naturally rises to the highest point, and meeting the cold pipes, is cooled, and drops down to the floor again.

The disadvantages of this system where temperatures above 30° F. are to be maintained, are the lack of proper ventilation and consequent formation of fog in the room, which is apt to produce mold on the goods stored. Where frozen goods are to be stored at temperatures of say 15° F. or 20° F. direct expansion pipes are found as a rule to be very satisfactory on the whole.

Another disadvantage is the necessity of having drip trays under all direct expansion pipes, even in freezing room, so as to catch the melting ice and snow which falls from the pipes when the compressor is stopped.

Brine Circulating System.—This system works on exactly the same principle as the direct expansion system, except that in place of having ammonia expanding through the pipes in the rooms, brine, which has been previously cooled by direct expansion pipes, is pumped through the pipes in the rooms. Brine circulation is also used in ice making, on what is known as the can or cell system. In this method of ice making the ice is frozen in rectangular cans or molds, which are inserted to the brim in a large tank containing brine. The brine is cooled by expansion pipes, and is kept in constant circulation by means of a propeller. In ice making on this system clear ice is obtained by agitating the water in the cans; this agitation bursts any air bubbles which form on the ice while it is freezing, but even with agitation there is generally a white core near the centre at top of the mold. Another system in use for ice making is to have brine pipes made into racks so as to form, as it were, walls of pipe; these racks are immersed in the water to be frozen, and the ice forming on both sides of the wall of pipes, we get what is known as plated ice. Very clear ice may be obtained by this process.

The Linde Patent Air Circulating System.—This is the latest improvement in refrigeration, and is admitted by all who have used it to be the most satisfactory sytem of cooling stores, etc. In this system the NH_3 is expanded in coils wound in grid-iron shape and fitted together to form racks or walls. These coils are enclosed in an air tight insulated chamber, preferably at the top of the building to be cooled, and are supported on racks which stand in a shallow tank filled with brine. This brine is continuously circulated over the walls of coils; thus preventing the formation of frost and snow and maintaining the refrigerating coils at their maximum efficiency. The brine is also allowed to fall in a shower between the racks. At one end of the chamber containing these coils called the air cooler, a fan is placed which draws the air through ducts or trunks from the rooms to be cooled, and forcing it through the cooler returns it by other similar ducts to the rooms. During its passage through the cooler the air coming in contact with the brine showers and refrigerating coils are thoroughly washed and chilled, and by depositing any suspended moisture on the cold surface of the coils and brine, is dried and returns to the storage rooms fresh and sweet. This is invaluable in the chilling of freshly killed meat, and in the storage of delicate products, as any bad gases which arise from the goods are dissolved in the brine, and are carried away by an overflow from the cooler tank.

QUALIFIED ENGINEER holding first-class Ontario Association Certificate desires position to take charge of either steam or electrical plant or combination of both. Address **C.A.S.E.** c/o Canadian Engineer.

A COMPETENT BOOK-KEEPER wishes situation as accountant, or for general electrical work. Address, **R.H.**, c/o Canadian Engineer.

Mechanical Engineer

For head of draughting office in a factory, building stationary and marine engines, boilers, saw-mill, pulp and general machinery; four hundred employees. A graduate of technical school with at least ten years experience. This is a good opening for a bright, thoroughly up-to-date man. Address M.E., care of Canadian Engineer, Toronto. 10 3

The Canadian Engineer

VOL. VIII.—No. 9. TORONTO AND MONTREAL, JANUARY, 1901. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Asbestos Air Cell Covering	183
Barnes' Improved Three Wheel Pipe Cutter	181
Boiler Tube Cleaner, Improved	186
Bricks from Sand	181
British Iron and Steel Trade	180
Buffalo Center Crank Engine	185
Can. Ass'n Stationary Engineers	186
Canadian Australasian Cable	177
Canadian Engineering Enterprises	175
Canadian Soc. of Civil Engineers	185
Catalogues, New	197
Crane Co. at Paris Exposition	198
Electric Flashes	194
Electric Light and Gas Inspection	178
Engineers' Club of Toronto	186
Failure of Engineering Works	178
General Engineering Co. vs. American Stoker Co.	191
Imperial Trade Notes	181
Industrial Notes	192
Instructiveness of Failure	178
Jones Underfeed Stoker	184
Lunkenheimer Extension, The New	182
Marine Engineers' Ass'n	187
" News	196
Metal Trade of Gt. Britain with Can.	197
Midland Smelter, The New	188
Miner's Inch	184
Mining Matters	195
Otis Feed Water Heater	198
Personal	196
Railway Matters	193
Rawhide Gearing	180
Tar Macadam for Streets	176
Toronto Industrial Exhibition	176
Whiton Gear Cutting Machine	183
Winnipeg Waterworks	177
Winter Navigation of the St. Lawrence	178

THE OUTLOOK IN CANADA.

For Canada, the new century opens with the development of material resources on a scale, which, to say the least, was never anticipated by its average citizen two years ago. And what will strike our readers as being worth more than a passing reflection is that all the developments which have attracted the attention of the outside world to Canada in the past year or two, have been the direct outcome of engineering science. We cannot exempt even the wealth of the agricultural resources of our Western prairies, or the riches of the Yukon gold diggings from this debt due to the engineer, for though the latter is in the form of alluvial gold requiring only the primitive cradle and pan to attain a certain development, yet as a fact, steam and machinery have had to be introduced to accelerate the work and carry it on all the year round, while the railway and steamboat have been essential to solve the problem of supplies. As to the agricultural riches, even they could not be created under modern conditions without farm machinery and the railway. The "hardy pioneer," is no longer the man with the axe, but the railway engineer. But leaving aside such sources of wealth, the developments to which we refer as marking the turn of the century, are those in which engineering skill may be said to be the beginning and the end—such, for instance, as the mining, metallurgical, chemical, industrial, hydraulic, and electrical, works that are transforming the life of every province. In the East, along the shores of Cape Breton, an enterprising American, H. M. Whitney, by his faith and capital combined, has helped us to realize, what we only knew before, that if steel ships are not superseded by some other system of navigation, the Canadian Maritime Provinces are destined to be the seat of the greatest shipbuilding industry of the world, for on no other coast in the seven seas is there such a combination of coal, iron, limestone and other raw materials, all concentrated there by Divine order, with a people at hand who are the best raw material for both mechanics and sailors to be found on the globe. We have already given facts concerning the development of coal and iron mining, and iron manufacturing in Nova Scotia, and now we have to announce the investment of $5,000,000 by the Dominion Iron & Steel Co. in a new steel plant, which we understand will roll ship plates for the future steel shipbuilding industry. The great hydraulic and electric power plants that have come, and are still coming, into being in that region of rivers, the provinces of Quebec and New Brunswick are striking in their magnitude. The application of these powers to one industry alone—that of pulp and paper manufacturing—is in itself a phenomenon; for, possessing, as we do, millions upon millions of acres of untouched pulpwood forests, it has already marked Canada out the leader of the world's paper and pulp industry. When one begins to contemplate the possibilities of those vast unused water-powers of that unexplored Empire, stretching from the barren beach of Labrador to the wilds of Keewatin, one feels to be standing on the verge of the infinite. We know this great power, wasting itself through the centuries, is vast, but how vast we cannot tell, because only here and there have explorers touched the country and many of these large northern rivers are unnamed and unknown. Starting at Sault Ste. Marie, as his base of operations, another American, F. H. Clergue, with the same rare combination of faith, energy and capital as Mr. Whitney, is pushing his way by a colonization railway north towards James' Bay to disclose to the world what there is in this great northern Empire. He has built pulp mills, saw-mills, iron works, and chemical works; he is developing great iron mines and nickel works, and he is scattering colonists by the thousand in districts along his new railway which bid fair to make as prosperous settlements as those lately established in what is now central Ontario, but which three or four years ago was spoken of as Northern Ontario. On a section of this territory, stretching about 500 miles west from the southern point of James' Bay, much new light will be thrown by the enterprise of the Ontario Government in sending out a corps of surveyors and geologists last autumn to report upon the country. This report will be issued in a couple of

months, and it will show that the resources of this great block of unutilized territory are of themselves sufficient to make a populous province in the future. As for British Columbia and the great North-West Territories, we only know enough as yet to grasp the fact that their wealth in raw materials needed by man is beyond calculation. And all these materials and natural powers can be turned into use and wealth only by the skill of the engineer.

TAR MACADAM FOR STREETS.

The board of works and engineering staff of the city of Hamilton deserve credit for the consistent way in which they have carried out their experiments with tar macadam paving. As this method of metalling streets is now attracting considerable attention in other cities, those of our readers interested in municipal engineering will be glad of the following information on the method of laying tar macadam:

To begin with, the following are the specifications under which the streets of Hamilton have been laid with tar macadam; these specifications having been drawn up by E. G. Barrow, C.E., who has had this work in his special charge. "All earth or other material above the sub-grade shall be excavated, so as to conform to the level of the sub-grade, which will be twelve inches below the finished surface of the roadway; and should the sub-grade be above the level of the natural ground, then earth shall be deposited until the level of the sub-grade is reached. The sub-grade shall be shaped to the profile and cross section, which will be furnished by the City Engineer. After the sub-grade has been formed to the proper camber of the road, then it shall be thoroughly rolled with the steam road roller; and if by this means soft spots are revealed, they shall be filled with good solid material. The first six inches shall be made in the ordinary way for a macadam or Telford roadway thoroughly rolled. If so required, it may be made of hard broken stone, furnace clinkers, or brick rolled smooth and finished to the required camber of the road. Upon this shall be placed the tarred stone. The first layer—four inches thick—to be composed of stones capable of passing through a two-inch ring. On this a layer composed of fine gravel or quarry chippings, three-quarter inches thick, shall be placed, and well rolled in so as to fill all interstices. Before finishing, a dressing of screenings shall be scattered broadcast to be worked in by the traffic. All these layers except the last shall be thoroughly compacted by rolling. The stone to be tarred shall be heated on an iron floor, under which are flues from a fire, until the moisture is driven out. The material in its heated state is then to be thoroughly mixed with a sufficient quantity of tar. The tar should be boiled in iron kettles holding fifty imperial gallons, to which should be added a bucketful of pitch. Eight imperial gallons should be added to each cubic yard of the coarser material; and ten to twelve gallons of the finer kinds of stone. The work must be done in the summer months, and all work must be suspended during wet weather."

Owing to the presence of the lighter oils contained in coal tar, as it comes from the works, it has been found best to use refined tar for this work. The stone used is limestone from the Hamilton Mountain. The flags first laid are 10 inches to 12 inches square, and, say, 5 or 6 inches thick; and the tarred stone, of say, four inches' thickness, is rolled with a hand roller, the top dressing of ¾ to 1 inch also being settled with a hand roller, the heavy roller to be used last. The second day after rolling, traffic may be allowed.

The cost of this street paving has averaged 80 to 95 cents per square yard. This cost is based on labor at 18 cents per hour, as paid in Hamilton, and on a cost of $5 per cord for macadamizing stone broken during the winter months at $1.75 per cord. Hamilton now has 12½ miles of streets paved with tar macadam, including such streets as King, York and Stuart which bear the heaviest traffic of the city. They have required but little repair, though some of them were paved fifteen years ago, and one street, paved nine years ago, has, we understand, never been touched by the repairers since. One great advantage of such a paving in a climate whose winter brings penetrating frosts, is that the tar keeps out the water, and where there is no great moisture in a road-bed there can be none of those upheavals from frost which cause such havoc to cedar blocks, brick paving, and ordinary macadam.

FAILURE OR REFORM?

The facts laid before the special meeting of the Toronto City Council, by J. O. Thorn, of the Metallic Roofing Co., on the affairs of the Toronto Industrial Exhibition, have proved to be a complete justification of the plea that gentleman has been making for a reform in the internal management of that institution. The Toronto Industrial Exhibition has become in a sense a Dominion institution, and it will be a great pity if the needed reforms are made impossible by the obstinacy of the clique who now form the controlling element in the directorate. The gentlemen who compose this clique do not yet appear to realize that the Exhibition has reached the parting of the ways and must either go forward or backward. Mr. Thorn deserves the gratitude of the people of Ontario, and of the manufacturers of Canada in particular, for undertaking what must be to him an unpleasant duty. His criticisms, happily, are not of the destructive order, as those of mere critics usually are, but he has placed before the public a complete scheme of improvements in every department of the Exhibition. For the machinery hall, for instance, and other departments of interest to manufacturers, his suggestions are most practical. He advises that a concrete boiler-room floor should be put in, and that a traveling crane be erected for unloading and moving heavy machinery; that ventilators be put in the roof; that nothing but machinery be exhibited in that building. He also suggests more attention given to exhibits of processes of manufacture and demonstrations of workshop and factory operations. These and many other suggestions are given, most of which are within reach. Among the many facts brought to light by Mr. Thorn those relating to the operations of the Electoral District Society, as an adjunct to the Industrial Exhibition Association, cannot have failed to strike the public. The sole object of this society appears to be to enable the family compact of the directorate to carry out their own policy in spite of the efforts of other constituents in that body, who are

striving after reform. This forms an abuse which threatens the character and in fact the very existence of the association; and the sooner the Provincial Government ends the existence of the Electoral District Society, as it has the power to do, the better it will be for the future. Pressure upon our news columns prevents us from going into details, but the writer has had ample evidence that manufacturers interested in the Toronto Industrial Exhibition are overwhelmingly in sympathy with the opinions of Mr. Thorn, and with his objects in seeking that complete internal reform in the directorate which constitutes the only hope for the Exhibition's future.

THE WINNIPEG WATERWORKS.

We have received a letter on the Winnipeg waterwork difficulty, from James Esplin, engineer, now resident of that city, and the writer of several letters addressed to the Winnipeg papers attacking the city engineer. As Mr. Esplin's letter, though addressed to the Canadian Engineer, has already been published in the Winnipeg Tribune, we need only summarize the statements made, which are that the well was sunk before the building was erected, and the concrete walls of the "box," built up before the chimney foundation was prepared; that the concrete bottom of the pump pit was not put in for months after the side walls were built up, and that there was no bond between them. The chimney, he says, weighs much over 700 tons, and adds that before a single brick was laid on the base, the side next the well, and the pump pit, had sunk several inches, and that the brickwork was laid on this tilted foundation. With regard to the source of the water supply, he says: "The Ruttan-Hering report was based on the assumption that the water came from 'crevices in the rock,' and a line of wells was to be drilled in the rock with the supposition that each well would yield its 250,000 gallons per day. Now it was well known to every resident who took the trouble to enquire, that the water in the 'flowing basin' did not come from the rock, but did come from a water-bearing stratum above the rock, and this stratum does not immediately overlay the rock, but is separated from the rock by an intervening stratum of impervious boulder clay or till. This stratum of impervious till is some six to eight feet thick, and is overlaid by a stratum of gravel four to six feet thick, and which is the water-bearing stratum. If a well was sunk and piped to this sand and gravel stratum, it was always a flowing well if sunk anywhere within the limits of the flowing basin, but if the well was sunk and piped into the rock, such a well was not a flowing well." With regard to the inflow of water eroding the material on which the well curb rested, he says: "There was no erosion until pumping was started. The first test pumping was started January 15th, and stopped January 22nd, 1900, but there was no sign of any erosion during that test. The quantity pumped during that test averaged 2,523,520 gallons per day. The well had been finished over a year, and there was an overflow of nearly 300,000 gallons per day during the whole of that period. The C.P.R. had a well drawing from the same source ever since the road was built, and furnishing about 200,000 gallons per day, and the Gordon Ironside Company used about 50,000 gallons per day. All the other small wells together might draw 50,000 gallons from the 'basin,' or a grand total of about 600,000 gallons per day. This is certainly a liberal estimate of the total quantity the flowing basin will furnish, and providing the city gets it all, it will not begin to meet the demands, and if it was our only reliance, there would be no protection in case of fire. The council have, however, showed some wisdom in retaining the old pumping station at Armstrong's Point intact. The C.P.R. well is practically dried up, and they are about erecting a plant to take their water from the Red river, and have got permission from the committee of works to lay a pipe line from the river to their shops, and all the other wells in the flowing basin are dried up."

He then goes on to say: "There was a No. 10 centrifugal pump left in the well from the last test, and a No. 6 was also placed in position, but not used, and also a steam pump was hung on to the top of the curb —and it did the business. The steam pump and centrifugals were both run for many days, pumping for the first month or so about 2½ million gallons per day with a lessening output from day to day. The pounding of the steam pump loosened the silt under the curb —so that it started on its downward journey just when it was not wanted, sinking a considerable distance and is now held propped up on stilts about five feet long. The suction pipes had been connected—and no provision had been made to guard against the settlement of the well curb—or the pump foundation—although such a provision had been urged on both the engineer and his assistant. To make assurance doubly sure, a bed of concrete was filled in under the pipe, "between the pump pit and the well curb," so that the smallest settlement would ensure breakage. The north wall did not fall "by accident." This wall is built on a pinnacle of earth left between the excavation for pump pit, about 22 feet deep, and the well, 47 or 48 feet deep, and distant from pump pit excavation about 14 or 15 feet. The wall foundations were laid on old oak plank footings, about four feet long, laid crossways—and were about five feet below the surface, and trenches had to be dug 22 feet below the surface to make the connections of the two 20-inch suction pipes from the well with the pumps—one to each pump; also the pipe connecting the low-duty pump with the softening plant; also the suction pipe connecting the city service pump with the reservoir, and also a connection from condenser room to reservoir. In all five trenches had to be dug to a depth of 17 feet below the footings of the north wall, undermining the whole length of the wall, and we are told that it was an accident that caused this wall to fall and the chimney to totter. The pumps are now pumping to the city about one million gallons per day or less, and the water is being steadily lowered in the well, and it has now reached a point that air is frequently drawn through the foot valves, requiring the old plant to be often started up in order to meet the demands of the city."

—Canadians in general, and the Canadian Society of Civil Engineers in particular, of which he is an honored member, will proudly rejoice to know that the scheme of the Canada-Australasian cable, which Sir Sanford Fleming has so perseveringly advocated, has had a successful issue, and that the contract for this, the longest single submarine line in the world—nearly

9,000 miles—has been let. This result has been achieved in the teeth of the opposition of the eastern cable companies, which form one of the most exacting monopolies of modern times. No such result would have been possible, of course, if the members of the British Cabinet had been amenable to those submarine influences which a monopoly of this sort has the means of using. The establishment of the cable is of vast importance, not merely on its own merits, as the only great link lacking in the chain of communications of the Empire round the world, but in the prospect it holds out as the foundation of a State-owned series of cables for the whole Empire, as against the privately-owned corporations which now form so large a part of the imperial system of communications. There is no service which falls so naturally into State ownership as a cable and telegraph service, for under such management the commercial interests would be sure to get the benefit of the lowest rates consistent with good maintenance; while in time of war the complete control of cables would be of the highest moment to the Imperial Government. Sir Sanford is now strenuously advocating State ownership, and no doubt Joseph Chamberlain, the Secretary of State for the Colonies, will be found in sympathy with an idea which will do much to help on the unifying processes that are now going on over the British Empire.

—The recommendation made by John Kennedy, harbor engineer, Montreal, for prolonging the period of navigating the St. Lawrence, is a most important one. Experience in operating the ferry between Quebec and Levis shows that by the use of steamers of moderate power the ice blockades can be prevented, or if suddenly formed, they can be broken up again before attaining very great strength. The conditions at Cap Rouge, where a big ice jam usually takes place in the spring, are so nearly like those of Quebec that Mr. Kennedy believes the ice difficulty can be dealt with at this point in such a way as to give at least ten days more of navigation each season. In the winter of 1886 no blockade was formed at Cap Rouge, and the main channel of the river remained open from Three Rivers right down to the Gulf, which is ground for assuming that if Cap Rouge can be kept free, the whole river below that can also be kept free. Mr. Kennedy thinks that by employing an ice-breaking steamer, like the "Stanley," this can be accomplished, and the Lower St. Lawrence kept open for navigation possibly all winter in some seasons. Judging by the adventures of one of the ocean steamers, which attempted to come up to the Bay of Chaleur last spring, when it was caught in thick masses of field ice, the winter navigation of the Lower St. Lawrence must be classed as a problem yet unsolved; but nothing appears to be impossible to modern engineering science, and we need not be in much doubt that the thing can be done. It will become more a question of the cost of maintaining the open channel against the profits of the extended season, than a question of the adequacy of engineering skill to accomplish the end. It will at all events be well worth a thorough trial, and if the experiments are as successful as those that have been recently carried out by the Russian Government in keeping up navigation in Russian waters that were formerly ice bound, the results will be satisfactory. At the beginning of the present century, sailing vessels crossed Lake Ontario from Niagara to Toronto, and from both these points to Kingston, all winter, and if these wooden craft could maintain winter navigation depending on wind only, the prolongation of the present season of winter navigation by means of strong steel steamers, specially constructed, ought to be accomplished with little difficulty.

—The annual report of the Inland Revenue Department, dealing with weights and measures, gas and electric light inspection, has just been issued. From this it appears that the two services of gas and electric light inspection have now become self-sustaining. The total revenue from the gas inspection, for the year ending June, 1900, amounts to $21,106, and the expenditure, $22,706; the total revenue from the electric light inspection reached $14,416, and the expenditure only $3,718, so that the surplus on the electric light inspection more than covered the deficiency on the gas department. The fees for the inspection of electric light amounted to $9,824, and fees for the registration of companies, $4,592. The report on gas inspection shows that in only two towns—Windsor, Ont., and Moncton, N.B.—did the illuminating power of gas ever fall below 16 candle power, while in quite a number of towns the candle power runs up to 22 and never below 18. Woodstock, Ont., shows the highest record, the lowest being 21.12 candle power, four other tests showing over 25 candle power, and one as high as 31.30 candle power. Deseronto comes next with one record as high as 25.40 candle power. Toronto gas runs from 18.14 to a fraction over 20 candle power, only one test showing 21. Montreal ran from 17 to 21.87 candle power; while Montreal gas shows less ammonia and more sulphur than Toronto gas; but Ottawa gas has a better record in all respects than either city. Of the 7,727 electric light meters presented for inspection, 2,929 were passed upon as correct, 2,380 were found to run fast, and 2,280 to run slow, but in each case these were within the limits of error permitted by the law. Only 78 were rejected as running too fast, and 15 as running too slow, while seven were rejected for bad construction or as being "unsound." There are about 300 electric light companies registered under the Act; and the total number of arc lamps operated was 11,920 and of incandescent lamps, 679,101.

THE INSTRUCTIVENESS OF FAILURE.

Editor Canadian Engineer:

You have taken hold of the Chambly dam failure and shown its weakness to have been due to there being too many sluices, no less than 15, and too close together in such a comparatively short stretch of dam. This is a splendid lesson for engineers as to what to avoid; and if what is said about the cement be true, engineers must also profit by the recital. You have also in your last issue given, from Engineer Jennings' report on the subject, a most instructive account of the failure, or accident, at the Winnipeg waterworks. My advice to you, gentlemen, in the interests o your own success and of your readers' professional advancement in engineering lore, is that you continue to pay particular attention to all accidents and failures. Too many accidents to buildings have been allowed to go by without enquiring into their why or wherefore. We have never been informed as to the exact cause of by-gone accidents at the drill shed and St. Patrick's Hall, the building in City Councillor

street, and that of the building for the Street Railway Co. on Craig street, Montreal. Our last accident in Quebec was that of a building at corner St. Andre and St. Thomas streets, where some 50 feet in extent of the wall on Andre street came down by the failure of the supporting piers of brick and stone, due to the difference in settlement between the mortar in the brick joints, as compared with that in the stone joints, and from want of headers in the piers, which, therefore, bulged at centre of height and gave way. This case is most instructive on account of the fact that the piers bulged and fell inwards instead of outwards as usually occurs, owing to the fact that though there were four mortar joints in the brick to one in the 12-inch layers of stone, the brick laid dry or without being watered sucked all the moisture from the mortar, dried it and rendered it incompressible, while the mortar between the stones remained wet and subject to compression. The compression, therefore, occurred on the outer face of the piers, bulging them inwards and causing them to fall inwards as stated.

When, some years ago, a portion of the front or portal wall of the new St. Jean Baptiste church, Quebec, had to be demolished and rebuilt, it was due to the fact that though all of stone, the outer face was in thick layers, while the backing was made up of rubble masonry where the compression being greater on the rear face was forcing out the front half of the wall, which had separated by some three inches from the inner.

I remember, now some 40 odd years ago, how in April an interior wall of the Academy of Music (planned and erected by myself in 1854), recently burnt down and now about to be rebuilt—that is the interior of it only, as the facade of Montreal stone is uninjured—failed on account of its having been built of unstratified "black stone," taken from the excavations during a rainy season, and left exposed to wet and frost during the preceding winter. Here you have the reasons of its failure set forth with the additional one of its being as yet unsupported by any floor beams to give it lateral resistance.

The failure at London, Ont., of the flooring of one of the rooms of the City Hall, with an audience in it, was explained at the time by the writer, in The Canadian Architect, as due to the giving way of a defective beam having a knot at the point of fracture: but which might have failed in any case, the computation of its strength as due to breadth of beam, square of depth and inversely as the length, not bringing out the dimensions required to allow anything like a proper factor of safety.

The floor beams or joists of part of the north wing of the three upper stories of the new city hall, Quebec, had to be replaced, after the building was floored, finished and painted, at an expenditure of some $5,000 more, by stronger, stiffer ones due to the fact of the joists being too scant or too narrow, too shallow and too far apart, as the writer had predicted, and thereof informed the building committtee before they were put in. The undersigned, some five years ago, explained how an unfinished 500-ft. span of a new bridge between Louisville and Jeffersonville in the United States gave way, due to the swaying back and forth of the supporting false work during a gale of wind. The supporting bents in this case were 40-ft. out of water, and 20-ft. in water, or of a total height of 60 feet. They were braced together in pairs, up and down stream, or the way the wind blew, but the bracing was only at the upper 14 feet, leaving 46 feet of the piles or standards unbraced, and thus free to act, while the bracing should, in additional tiers thereof have been carried down not only to river level, but to at least 10 feet below that level to guard against the sway which brought about the failure of the structure.

Reservoir dams have failed time and again as at Johnstown, Austin, etc., in America, Bouzey in France, and elsewhere, from insufficient weight of masonry to stand the pressure. Retaining walls of inland works have failed, and failed and failed again a third time within the memory of the writer, who has been witness to the second and third instances thereof; all these failures due to back pressure of the filling-in behind them, which when of loose earth or sandy soil may and do, during wet weather, become water-logged, and like so much quicksand. The walls of the new Quebec docks supply an necessary to guard against in this country in all cases of back instance where bulging is due to frost expansion, which it is so filling.

There are other failures for which engineers and architects are responsible that are not of such a palpable nature, as where drainage overflows the highway or inundates a cellar or a basement, from insufficiency of size and want of depth, or of sufficient grade in sewers, or where water supposed to flow into a reservoir at a certain height fails to do so, or does so in an imperfect manner, as was the case at the new jail, Quebec, erected after the plans and under the superintendence of the writer in 1860. Here a 4-inch main had been laid from Mount Pleasant, a distance of 1,800 feet, to reach the Grand-Allee, where the jail is situated, and though the static pressure was sufficient to raise the water to fully 130 feet above the level of the cisterns in the attics of the building, it failed to do so, or rather the water only trickled into them. The reason, though suspected, was not in this case apparent to the eye. It had to be found out, and to do so—there being an 18-inch main beside the 4-inch on the Grande-Allee—I put in a piece of 2-inch pipe between the 4-inch and the 18-inch. The water then, as if by magic, immediately flowed abundantly into the cisterns at some 60 to 70 feet above the roadway at that point. The suspected cause was thus shown to be the real cause of the previous failure to deliver. It was thus made certain that the mere frictional retardation of the flow through suh a length of small sized pipe (1,800 feet as already stated), was the true and only cause, and thus, and in other ways and in other cities long stretches of pipe of small bore have been shown to be responsible as at Sherbrooke and at Quebec, and elsewhere, for disastrous fires which could not be reached, owing to this insufficiency of flow and reduction of static pressure, when hydraulic requirements—water in motion—came into play.

The Winnipeg occurrence already alluded to and so fully and clearly described in this journal, was no doubt due to the action alleged by Mr. Jennings, though he is not quite sure that the trench digging and wet weather had not something to do with bringing about the settlement of the chimney stack, which caused it to tilt over some 15 inches. Yes, as Mr. Jennings surmises, the rush of water into the well, to have caused the curb to sink and settle as it did, must have sucked away the sand or loose material from beneath it, and even to some extent from beneath the foundations of the chimney. Let every engineer not fail to read this article of yours, so plainly and instructively illustrated as it is, in a way to be comprehensible to everyone, and let all of us profit by the excellent lesson it affords.

Other accidents have occurred due to the nature of the soil, as when at Joliette, at St. Bazile, at Nicolet, the portal in each case was torn away from the body of the church, due to the fact that the foundations under these heavier portions of the several structures were not of sufficient breadth of base to equalize the weight over the total area of the building and cause it to settle equally throughout; for like a vessel on water, a building may be erected on any depth of a soft or yielding bottom provided it be so calculated as to settle equally, by proportioning the supporting area of the foundations to the weight to be upheld. A church at Cornwall, Ont., met with the same fate, its portal or heavier wall having sunk as much as two feet below the level of the remainder of the building. At Nicolet the last accident was due to the pillars in the basement failing to support the weight, from being a shell of 8-inch brick work filled in with the loosest and poorest of concrete backing.

I do not believe one of our engineers of the present day knows, or if he did at the time, still remembers, how the fall of the 400 foot suspension bridge across Montmorency river at the crest of the falls, took place. Suspension bridges were then built of links, instead of, as at present, continuous wire cables. The contractor relying on the virtue of concrete, its resistance to compression, had omitted the stone blocks, which were to have acted as points of support for the articulations of each nest or set of links, allowing them to bear directly on the concrete bed, which the stone blocks were to have been laid on. The concrete gave way, under the strain of the span between the piers, the pin articulations or joints between the 7-ft. links on either side thereof sank as much as 8 inches into the concrete, thus bringing intermediate points or portions of the links—just where they entered the anchorages—to bear on outcropping scrags or ledges of solid rock. The link bars thus submitted to a transverse strain were broken across, one by one, until finally one chain gave way, and then the

other, when the whole superstructure plunged into the abyss below with a horse, vehicle, woman and boy who happened to be crossing at the time of the occurrence. This statement may be relied on, as the writer reported the same to the Government, at whose desire he and the late Mr. Trudeau, of the Public Works, Ottawa, and another gentleman whose name he now forgets, made the survey and reported to that effect. The loss of H.M.S. "Victoria," stove in by the "Camperdown," and of the "Burgoyne," wrecked in the same way, I have explained to be due to their longitudinal bulkhead preventing the inrushing water from spreading equally across the hull of the vessel.

Gentlemen, you have initiated the right thing. Please continue to do this, Mr. Editor, and your journal will thus become doubly interesting and instructive. Nothing is to be learnt from a structure which does not fail, but one that does is full of instruction.

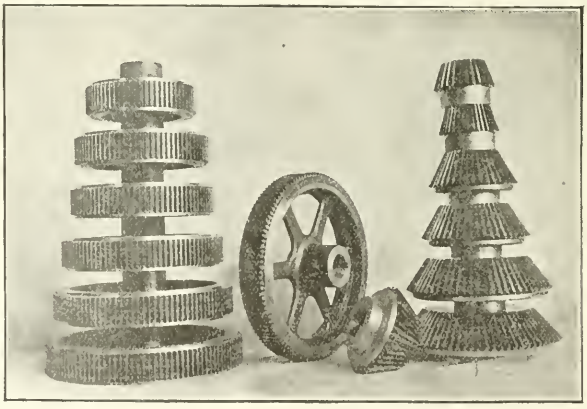
Quebec, Jan. 1st, 1901. CHARLES BAILLAIRGE.

NOISELESS GEARING.

With the constantly increasing use of geared machinery comes a general demand for gearing, which will do away with the annoying humming sound made by metal gears when run at high speeds. Many substances have been tried for this purpose, but the material which seems to be coming most rapidly into use is specially prepared raw hide. The New Process Raw Hide Co., of Syracuse, N.Y., claims to be the only concern in America which makes the raw hide gears complete from the green hides. This concern has its own tannery where the hides are prepared by a patented process, and a complete machine shop, equipped with the latest gear cutters and other machine tools, where all its machine work is done. The raw hide, after being thoroughly cured, is cut into discs, which are pressed together in cement by a high-

power hydraulic press. Then these blanks are riveted, turned on a lathe, and lastly have teeth cut in them on an automatic gear cutter in the same manner as for metal cut gears.

The smaller of the accompanying cuts shows a raw hide gear blank riveted and turned ready for cutting. The larger cut shows a few samples of large gears recently made by the New Process people for a big eastern manufacturing concern. The largest of these gears are made with metal centers in order to reduce to a minimum the amount of hide required. The largest spur gear ever made by this company, and undoubtedly the largest raw hide gear in the world measured 36⅛ inches outside diameter. The same people have made a raw hide bevel gear within an inch of this size.



BRITISH IRON AND STEEL TRADES.

Notwithstanding the much talked of competition of American producers the iron trade of Great Britain has continued to advance during the past year. The total exports of iron and steel for eleven months of 1900 reached a value of £29,826,697, against £25,473,955 for the corresponding months of 1899, which again was about £5,000,000 over the like period of 1898. We make the following extracts from an interesting report sent us by Bolling & Lowe, London, E.C., on the iron, steel and kindred trades of 1900:

Ore.—The question of future supply of iron ore to Great Britain is of great importance, as we still depend very much upon that imported from Spain and elsewhere. The United States have their home supplies well developed, and Germany, whilst importing from Spain and Scandinavia, etc., is in a similar position, having large reserves of ore in their own countries.

Pig Iron.—The present stock of pig iron in Glasgow is lower than it has been for 20 years, being under 80,000 tons, whereas in the year 1887, the record stock was held, amounting to nearly 943,000 tons.

Finished Iron and Steel.—The year has been a prosperous one for manufacturers, who have been busy with home and export orders. During the last few months, however, fresh business has been difficult to obtain, and a general weakening of prices has commenced. So far as we can judge, manufacturers are likely, for a time at any rate, to make further concessions.

Tin Plates.—There is very little to say about this article now that the American market is practically closed to us, except that we may shortly find American manufacturers competing in this trade as in others.

Shipbuilding in the United Kingdom has not been on such an extensive scale this year, buyers, confident of reduced prices in the near future, holding back their orders. The designing of vessels has reached such perfection that ships of 10,000 tons burthen do not require a larger crew than was necessary 20 years ago for a ship of 3,000 to 4,000 tons, steaming at 10 to 12 knots an hour with hardly any greater coal consumption. Prices of steamers are to-day 35 per cent above those in 1897, whilst at the beginning of this year they were as much as 50 per cent higher.

Coal.—The year's output is expected to approximate 230,000,000 tons, in spite of enhanced prices. Of this quantity about 60,000,000 tons have been exported, and the remainder, 170,000,000 tons, consumed at home by industrial concerns, railways, gas works, etc. In consequence of the advanced cost

of fuel, makers of finished materials have naturally raised their prices, and the foreign consumer has doubtless paid for the increased value of about 100,000,000 tons of coal—say £25,000,000. The tonnage is made up approximately of 60,000,000 tons shipped as above, and 40,000,000 tons represented in the working up of material for export. Every additional advance of one penny per ton on the price of coal means on the total output about £1,000,000 extra profit. Wages in the S. Wales collieries are now higher than they have ever been. Owing to the high price of coal, great impetus has been given to the employment of liquid fuel, which is found principally in Russia, United States and the East. It will doubtless be more extensively used in the future. It was officially announced in St. Petersburg on the 25th October, that the Minister of Ways of Communication had decided to use naphtha on all locomotives running on the Russian railway system.

The "boom" has passed, but these cycles of prosperity are not so beneficial as is imagined, owing to the enormous speculation, not by consumers, but by a certain trading class with little or nothing to lose, and everything to gain, and by outsiders who simply want to "spec." To our knowledge some months ago certain works had sold every ton of their make for delivery over this year. Unfortunately specifications against the contracts have not been forthcoming, and the material has been in the market again, and sold in part, at prices much lower than those at which the original contracts were made. The first buyer may have had to pay something to cancel the contract, but in the meantime the material is offered right and left and in consequence the end of a "boom" is in sight.

Stocks of Iron, Steel and Coal.—All parts of the world can be reached by steamer from Europe within six weeks, with the exception of the Northern Pacific ports, and large stocks are only kept as a speculation. The tendency now seems the other way, i.e., to keep as small supplies as possible, as, in the opinion of the trading community, the capital locked up, and loss of interest, are not sufficiently compensated by the value of merchandise held in stock, which has to be disposed of at varying values in the unknown future.

Labor.—It becomes daily more evident to every country that the burning question of the time is how to secure employment for its ever growing population. The Old Age Pension movement continues to find increasing favor abroad, whereas but little progress has been made here. If a scheme which would throw no greater financial burden upon the people than the present poor rate system does, could be devised, it would make very little difference to the public if Old Age Pensions were to take the place of poor relief, and by the transference of the financial burden from the ratepayer to the taxpayer, the working man would himself help to provide his pension. It is impossible to give too much encouragement to sound schemes that have for their object relief for the working classes. We say this from no undue feeling of sentiment, but it is obvious, even to the least liberal, that the best security offered against the disorganization and loss of trade by strikes and trade disputes of any kind, is a better feeling between employer and employed on the one hand, and the confidence engendered by an assured provision for old age on the other. Associated with this most important subject is the relationship between the working men's leaders and other classes; and it seems to us, looking at the matter from a commercial point of view, that it is very desirable for the secretaries of the chief trade unions to be members of the Chambers of Commerce, when close and constant intercourse might remove many wrong impressions and misunderstandings.

BARNES' IMPROVED THREE-WHEEL PIPE CUTTER.

This widely known tool is made in eight sizes and the two styles illustrated, and is used in cutting pipe from ⅛ to 12 inches in diameter. The cut illustrates Nos. 1 and 2, used for the various sizes of pipe up to 2 inches in diameter.

This design is furnished in six sizes; No. 3 cuts pipe from 1½ to 3 inches in diameter, No. 4 from 2½ to 4 inches, No. 5 from 4 to 6 inches, No. 6 from 6 to 8 inches, No. 6½ from 8 to 10 inches and No. 7 from 9 to 12 inches. The makers of the original Barnes' three-wheel pipe cutter, under the patents issued to E. F. Barnes in 1883, are the makers of the first

three wheel cutters that ever worked successfully. They are also makers of the first cutters to cut pipe over four inches in diameter, and they are recognized as the standard pipe cut-

ters all over the world. There are other three-wheel cutters made to sell on the Barnes' reputation, but all Barnes' tools have the registered trade mark stamped, as shown in illustration.

The cutter wheels are drop forged from Jessop's best tool steel, and while they could be made from American

BARNES' TOOL CO.'S TRADE MARK.

steel at less expense, the makers find that Jessop's steel stands up better under all strains. All genuine Barnes wheels have "Barnes or B. T. Co." stamped on the hubs. For further information address The Barnes Tool Co., New Haven, Conn., U. S. A.

IMPERIAL TRADE NOTES.

The following are among the enquiries relating to Canadian trade recently received at the Canadian High Commissioner's office in London. Addresses of the firms can be given on application at this office:

A north of England firm who are already engaged in the importation of eggs, cheese and butter, etc., are open to buy further supplies from Canada, and desire to be placed in communication with some large exporters in the Dominion. The names of sound business firms in Canada who deal in mining materials are asked for by the manufacturers of steel wire screening for gold mining. Two applications have been received for names of asbestos mine owners in Canada. The manufacturers of tinned, japanned and enamelled hollow-ware, who have shipped several consignments of enamelled ware to Canada, are anxious to push the business, and will be glad to hear from Canadian houses interested in it. Enquiry is made by a Canadian correspondent for the London agents of Swedish makers of cream separators and other dairy machinery of the latest types. A correspondent in Montreal asks to be furnished with the names of automobile manufacturers in Great Britain desiring to be represented in Canada.

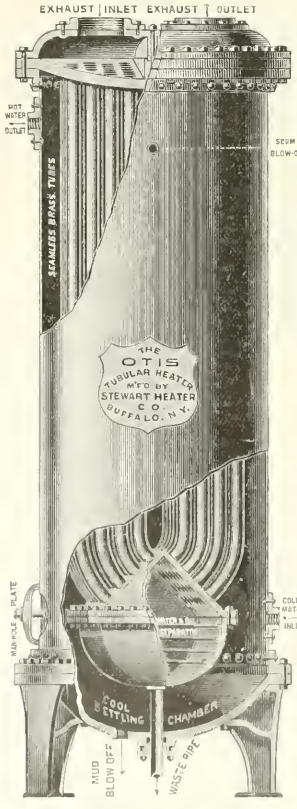
BRICKS FROM SAND.

An Ontario subscriber asks, "Can you give me any information about a process invented by W Olschewsky for making bricks from sand?" The process our correspondent enquires about is one by which bricks are made from a mixture of pulverized sand and chalk, the mixture being acted on by steam in a cylinder which is sealed up after being filled with the bricks. The action of the steam is intended to convert the mixture into a silicate of chalk. We may say that an attempt was made to form a company a year or two ago in

Montreal to manufacture bricks from sand, but the company never got into operation. We believe also, that a firm or company in Sarnia or Windsor sent out some samples to Toronto firms, but they never followed up their efforts. The fact is a brick made from sand can not compete with clay bricks in price, and it is not every kind of sand that can be successfully used for this purpose. It needs a hard clean sand, and the bricks made by this process are chiefly serviceable for ornamental purposes, and for this reason the consumption would be limited.

THE OTIS FEED WATER HEATER.

As there is no piece of machinery that will pay for itself so soon as a good feed water heater, our readers will be interested in a description of the Otis Tubular Feed Water Heater, Oil Separator and Purifier, manufactured by the Stewart Heater Co., of Buffalo, N.Y., and now being introduced to the Canadian trade. It will be noticed that the exhaust pipes are connected at the top in this heater. This is done to provide a cool settling chamber and oil separator at the bottom where the sediment will settle below and away from the tubes, there to remain soft and easily removable. The makers guarantee that this feature will prevent the heater from becoming foul with scale, and that it will continue to heat as hot after years of use as when new. This is the only heater that has a cool settling chamber at the bottom. As the tubes are suspended from the top in this heater, they are thus free to contract and expand, and the company guarantee they will not become loose and leak by reason of contraction and expansion, as they are apt to do in all straight tube heaters.



The oil separator connected at the lower end of the tubes that separates the water of condensation and the oil that is carried over from the engine cylinder with the exhaust steam, makes it practicable to use the exhaust steam after passing through this heater, for heating buildings, etc., and return the condensation from the heating system to boilers, without the extra expense of an additional oil separator or eliminator. As this separator is surrounded at all times by cool water, the makers guarantee it will remove more oil from the exhaust steam than any eliminator in the market, as it is a well known fact that oil will chill very easily, and then must drop to the bottom, where it is carried off through the drip pipe that leads from the separator through the stuffing box in the bottom of the heater, as shown in the cut. Each heater is tested to 175 lbs. hydrostatic pressure before shipment is made, and guaranteed perfect. There are over 400 Otis Heaters now in use in Buffalo alone, which shows that they are well liked at home, and when such firms as the Barber Asphalt Paving Co., of New York City will order one after another until they now have 20 of them in use in their different plants, it is evident that they are saving money for them. Regarding their methods of introducing this heater to new customers the company state: "We ship the Otis Heater on its merits, and guarantee it will give perfect satisfaction in every respect. If it fails to do as represented, we agree to pay freight, cartage and all cost of the trial, heater to be returned to us at our expense. If you will send us the size of your exhaust and feed water pipes, also about the h.p. of your boilers, or if you will select a heater of the proper size from our circular, we will name you our best jobbers' price and guarantee the results."

JOHN R. BARLOW, CITY SURVEYOR, MONTREAL.

John R. Barlow, Mem. Can. Soc. C.E., was born in Stornoway, Isle of Lewis, Scotland, in 1850. He came to Canada, when young, with his father, Robert Barlow, formerly of the Royal Engineers, and lately of the Geological Survey, under whom he studied his profession. In 1872 and in 1874-5 he was employed in the Geological Survey of Canada, while 1873 was spent at various works in the United States; in 1876 he was engaged by the city of Montreal to make the surveys for the homologated plan of the city. In 1880 he worked for a short time under J. A. U. Beaudry, P.L.S. and C.E., when he was constructing the St. Henri waterworks. In 1881 he was again employed by the city of Montreal to make a contour plan of the city, on the completion of which he was appointed assistant city engineer. In 1892 he was promoted to be deputy city surveyor, which position he held until last month, when he was again promoted, this time to be city surveyor in succession to P. W. St. George. He has therefore been in the city's employ for twenty-three years, and during that time has been employed on every class of work that was done.

THE NEW LUNKENHEIMER EXTENSION.

The new machine shop building, which the Lunkenheimer Company has just completed, is situated on the block bounded by Tremont, Waverly and Lawnway streets, Fairmount, Cincinnati. This building is 90 by 170 feet, two stories and basement, and is built on the usual machine shop gallery style of construction. There is a traveling crane thirty feet wide, which runs the full length of the building, leaving galleries on the second floor, on both sides, thirty feet wide. The construction is steel throughout, and designed to safely carry a load of 300 pounds per square foot. This building was erected to take care of three important departments of the company, viz., iron

valve, injector and safety valve. It is, strictly speaking, a model machine shop, and is equipped throughout with the very latest tools and appliances. The steam plant consists of a 125-h.p. special boiler built for a safe working pressure of 400 pounds per square inch. In connection with this boiler there are a number of appliances for testing all goods under steam, air and hydraulic pressure. The building is lighted by electricity, and the power is furnished by a 100-h.p. engine. The building shown in engraving presents a very handsome appearance, being pressed brick throughout. The location is an excellent one for manufacturing, railroad facilities are ample, a track spur from the C. H. & D. railroad leading to one side of the building. The erection of this building will not, in any way, reduce the building now occupied by the company on East Eighth street, Cincinnati, which will hereafter be entirely devoted to brass work. By the present new building the manufacturing facilities have been increased about twenty-five per cent., and employment is given to 100 men in addition to the force already operated, bringing the total force up to 500 hands, all of whom are engaged in the production of strictly high grade brass and iron goods and engineering appliances.

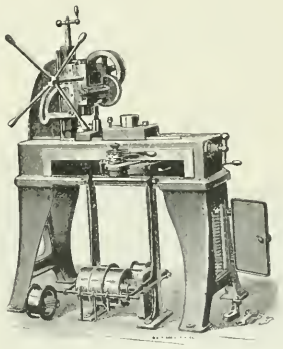
The Lunkenheimer business was founded by Frederick Lunkenheimer in 1861. It was started in a small way, but soon began to grow, until in 1867, larger quarters were occupied, where now the Columbia theatre is located. In 1881 it required larger quarters, and the new factory was built on 8th

street between Main and Sycamore. The business was incorporated in March, 1889, and reorganized in 1892. The officers are: E. H. Lunken, president; D. T. Williams, vice-president; C. F. Lunkenheimer, treasurer; S. L. Moyer, secretary; Wm. Muench, auditor. The superintendent of the manufacturing department is Henry Ritter. For several years the business has increased so rapidly that the present quarters are outgrown. In the spring two more buildings will be added, as well as a large foundry 100 x 180 feet, and when completed, these works will, it is said, be the most extensive and finest in this line of business in the United States. The company manufactures high-grade brass and iron work and fittings for steam engines and boilers of every description, consisting principally of the celebrated Lunkenheimer valves, injectors, lubricators, oil cups, whistles, safety valves, etc. They also manufacture a great variety of special work used in connection with steam, water and compressed air apparatus for stationary and marine purposes. It is only natural that in the way of foundry work, they cast almost anything made of brass, from the lightest to the heaviest class of work. Their goods are shipped to all parts of the United States and Canada, and also used extensively in foreign countries, especially England, Germany, Russia and Australia. Their exhibit at the Paris Exposition this year was one of the leading ones in this line, and they were awarded three silver medals, the highest in their respective class. The managers of this company are all young men, less than 40 years of age.

The town council of North Sydney, C.B., proposes a sewerage system for the town. It is expected work will commence next spring.

WHITON'S IMPROVED GEAR CUTTING MACHINE.

The illustration shows a hand gear cutting machine. The design shows great convenience of adjustment and operation upon the varieties of work for which such a machine is found so useful. The cutter and work in the Whiton are always in full view. The work holding spindle embraces features which show that the machine has been carefully studied out, and the frame is a single casting, rigid, and accurately finished. The cutter head adjusts vertically to any convenient height, can be set over at any angle for bevel gear work. The cutter spindle is accurately fitted in a transversely sliding bronze box. Has adjustment for taking up wear, and adjustment for setting gear central, or trimming the sides of bevel gear teeth. The spacing mechanism is protected from chips and dirt, has a set of ratchet discs, uniform in diameter, varying in numbers of teeth, any of which may be applied to the upper end of the pinion shaft, regulated by a pawl automatically spacing the blank. While not an automatic machine, it is so simple and convenient that a large amount of work can be produced by ordinary labor without danger of mistakes being made. This machine will cut spur, bevel and worm gears to 30 inches diameter by 6¾ inches face, 6 pitch and finer, and does especially good work on sizes under 15 inches; can also be used to finish special nuts, bolt heads, etc., by means of side or straddle mills, and will perform any radial milling, and with a



Whiton's Gear Cutting Machine.

center attachment will flute taps, reamers, either straight or taper. With a vise attachment it becomes a convenient hand-milling machine adapted to a variety of work, and oftentimes it is a satisfactory substitute for expensive universal milling machines. The machine will divide for all numbers up to 100, even numbers to 186, and a wide range of higher numbers. Rack cutting attachments, and also high speed attachments for brass work, can be supplied. The D. E. Whiton Machine Co., of New London, Conn., also manufacture an improved power feed, or semi-automatic gear cutting machine, similar in construction, provided with a power feed cutting head, and also manufacture a very complete line of lathe and drill chucks. Their lathe chucks having the experience of 40 years behind them can be depended upon when quality, strength and the latest improvements are desired by the machine shop. A complete catalogue, giving names of textile manufacturers, and others, who are using the machines and attachments described above, which also contains very valuable information regarding gear cutters, gear tooth pitches, and standard sizes of hexagonal nuts and bolt heads, will be sent to those interested.

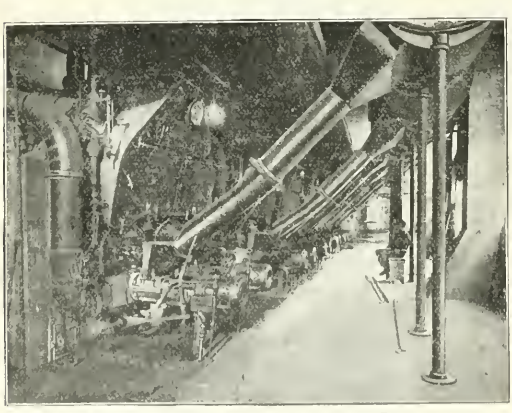
ASBESTOS AIR CELL COVERINGS.

The Fairbanks' Company of Montreal, in placing this pipe covering on the market are sending out a neat circular containing list prices of the pipe covering, boiler block and boards and rolls. The following points are claimed for these coverings: They will save 90% of the heat, which at 60 lbs. pressure, on 2-inch bare pipe means a loss per foot of $1 per year. The covering of all steam pipes and boilers means less coal consumption and dry steam delivered where required in a plant;

while the covering of pipes means less risk from fire from over-heated bare pipes, which are responsible for the burning of many buildings. The cellular covering is manufactured from asbestos, carefully selected, and is made up of longitudinal sections of trapped air cells, which heating experts consider an ideal method of insulating steam pipes. There is no waste of material as it is supplied in sections 3-ft. long, cased in canvas and is connected up with moulded fittings and metal bands, and can be supplied to fit pipe from ½-inch to 12-inch in diameter. It is made in three thicknesses, ½-inch, ¾-inch and 1-inch, to suit hot water, low pressure and high pressure steam. The Fairbanks Company will supply further information to parties interested.

THE JONES UNDERFEED STOKER.

On another page of this issue will be found an announcement relating to the above method of introducing fuel into a furnace. The best evidence of the value placed upon the Jones invention is the fact that two of the strongest companies on the continent have been engaged for some years fighting for the ownership. The company, with headquarters at Toronto, have finally succeeded in the Supreme Court of Canada, and will now have the exclusive right of installing the device in the Dominion of Canada, and will be entitled to an injunction and damages against all users of infringing devices. An idea of the value of this invention to steam users may be gained from the fact that the annual saving effected by four stokers in one plant in Montreal amounts to more than $7,000. and the saving effected in one Toronto plant is stated to exceed $15,000 per annum in the coal bill alone, while in every case, the efficiency of the boilers is very much increased, and the cost of labor considerably lessened. The economy effected by the Jones stoker would appear to amount to about $2.50 per day per stoker, or more than $750 for each stoker annually. The saving



No. 2 Boiler Room, Toronto Street Ry.

is so great that the manufacturers are prepared to fix the price of an equipment, and to accept payment out of the saving effected only as shown by a test made by the purchaser before acceptance. The stokers have been frequently installed under these conditions, and in every case to date, the purchasers have commuted the amount due and have settled for the stokers within a few months of the completion of the contract. In this way steam users may secure the benefit of this device free of cost. A further advantage claimed for these stokers is that the efficiency of the boilers is very much increased so that about one fourth less boiler capacity in many cases is required. Most devices effecting a saving in one direction increase the outlay in another, but it is claimed for the Jones stoker that the repairs are practically nothing and the life of the boiler is increased rather than lessened. These stokers have been in use both day and night steadily, in a large number of plants for the past five or six years, and in no case has the slightest injury been occasioned to the plant, while in nearly every case the cost of repairs has been reduced.

The cut here presented shows a number of these stokers in operation at the plant of the Toronto Street Railway. These stokers have been in constant operation for nearly three years, and have been forced to nearly 100% above their rated capacity. The stokers have stood the severest tests, and show an economy of over 20%, and a recent order has been given for the installation of four additional stokers, which will make the entire equipment twenty stokers; certainly one of the finest on the continent. There are many devices for consuming smoke. With the use of the Jones stoker properly operated no smoke is ever produced. No matter what smoke preventative is used smoke can be produced by a careless fireman. What is claimed for the Jones stoker is, that operating a light load it will equal any other device known in preventing smoke while with a heavy load it will easily outclass any other smoke preventing device on the market. The manufacturers are prepared to install the Jones stoker free of cost beside any other known device for saving fuel, preventing smoke and increasing capacity, and to guarantee a 10% better result with the Jones beyond the other device. In a recent competition of this kind with one of the best known smoke preventing devices in the United States, the results showed 20.2% of an economy in favor of the Jones over the smoke device, and only 15% economy over the hand fired, the conditions being identical in all cases. The Canadian Company, formerly the General Engineering Co., and now the Underfeed Stoker Co., Ltd., is composed of a number of the leading capitalists of Canada, and the company's head office is located in the National Trust Building, King street east, Toronto. The catalogue issued by the company is a work of art, and will be forwarded to steam users on application.

THE MINER'S INCH—A PRACTICAL SUGGESTION.

Editor Canadian Engineer :

Sir,—Your publication of a summary of Mr. Drummond's valuable paper on the above subject is much to be commended, since by this means the benefit is more extensive than were its publication confined to narrower bounds. The correctness of Mr. Drummond's work can hardly be open to doubt—so what could have been said in discussion would be of much interest to know. As a matter of business where we desire to measure water for sale by the gallon, by the pound or by meter, the Government steps in and demands that we pay fees, while our measuring instruments are periodically inspected and stamped. Here the boot is on the other leg—the Government has water for sale, and thanks are due to Mr. Drummond for accurately informing us as to the exceedingly shiftless and erroneous way in which their business in this respect is conducted. We cannot dictate to the Government but we may criticize and advise gratuitously if we please, so in regard to the letter here goes: Let a standard orifice be determined on (preferably circular, as easier to work and measure), let it be in metal, in shape of a bushing or lining for a standard sized hole that may be made in a plank, with suitable projecting flange or lugs for securing it in place; let a stock of these be subjected to expert manufacture, inspected, stamped, numbered and sold for a trifle, with the right to use when purchased. The depth allowable for insertion below the surface of the water must of course be given, or, by simple contrivance, this could be regulated automatically by float. One or more of these measures can be used according to amount of water purchased, and a variety of sizes in the units may be employed, if desirable. Periodical inspection can be employed with equal ease as in other measurements referred to. I submit this as a ground plan for a simple and efficient way of accurately determining in practise the miner's inch.

Robt. W. King.

—The London Times, editorially commenting on the competition of the United States in the steel industry, says: "It is useless to disguise the fact that Great Britain is being outdistanced The competition does not come from the glut caused by miscalculation as to the home demand. Our own steelmakers know better and are alarmed. The threatened competition in markets hitherto our own comes from efficiency in production such as never before has been seen. At the dawn of the century it is well to reflect on the truth that 'one of the most disquieting factors in the problem before us is that the United States has a trained body of young men determined to make their country great, and who have been educated to a living, practical interest in things needful to that end.'"

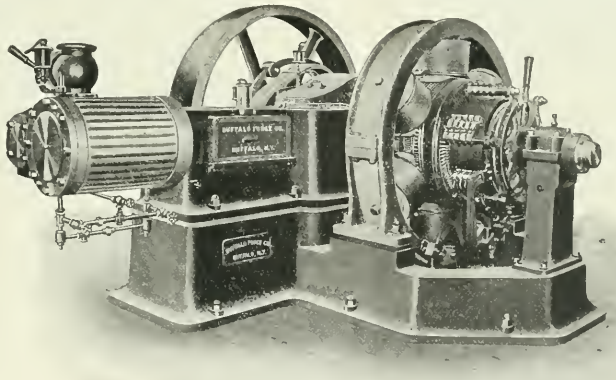
BUFFALO CENTER-CRANK ENGINE.

The accompanying cut shows one of the several types of high speed engines manufactured by the Buffalo Forge Company, of Buffalo, N.Y., illustrating in this particular case their standard horizontal center-crank engine direct connected to a General Electric Company generator, and now in operation in the Wagner Palace Car Co., Buffalo, N.Y. The heavy cast-iron sub-base furnishes a solid support to which to bolt the engine bed, and at the same time raises the engine sufficiently for the fly-wheels to clear the floor or foundation. In the case of dynamo direct connected this sub-base may provide a bed for the generator, and also carry the out-board bearing. The engine frame proper is a single casting of the center crank type. In the smaller sizes the cylinder is also cast thereon, and then the crosshead guides are bored at the same setting, and with the same bar with which the cylinder is bored. In the larger sizes, however, one cylinder head is cast to frame, and to this is bolted the overhung cylinders. In this case, the facing of the head and the boring of the guides is done at the same time. The importance of this method of construction at once appeals to the engineer who has had experience with "hot boxes" occurring when the slides are slightly out of line with the cylinder. The crosshead is fitted with cast-iron shoes lined with the best babbitt metal pinned in, and a ready means of adjustment is provided for taking up any wear between the shoes and the guides.

The cylinder is covered with a corrugated iron jacket which encloses a dead air space as a non-conductor. Radiation is further prevented by providing a dead air space in the cylinder head. The piston is a single casting cored thin, giving maximum strength with minimum weight, and causing but little wear on the bottom of the cylinder. Two or more packing rings are used on the piston. The rod is of machine steel turned to a taper fit, and secured by a single nut. A balanced piston valve is used and its pistons are also hollow. The valve rings are of the same width as the piston on which they fit, and are therefore flush with the sides. This feature prevents wire drawing of the steam as well as giving a large bearing surface to the valve. The rings are allowed to readjust themselves to the bore, and then the nuts can be tightened, thereby securing them in that position. The crank shaft and connecting rod are of forged steel, and the crank pin is of the same diameter as the shaft. The connecting rod is fastened to the crank pin by means of a strap and wedge. The wedge is completely enclosed by a strap and box and is securely held and adjusted by two lock bolts.

The valve motion is derived from an eccentric which carries the valve rod in a straight line. The eccentric strap is lined with babbitt metal of the best quality, and the trouble so common to eccentrics where cast-iron straps work on cast-iron sheaves is eliminated by this arrangement. The valve motion is controlled by a fly-wheel governor of the very sensitive type. This governor is provided with three means of adjustment, so that it may be accurately set to control the engine at any given speed; in addition grease or oil cups are provided on its every pin. Indeed, one of the most prominent features of this engine is its thorough system of lubrication.

The engine is enclosed to run in oil, and a positive means of lubrication is thereby furnished for the main bearings, the crank pin, wrist pin and crosshead slides. Where no special means is provided for the lubrication of the wrist pin of an engine running in oil (the oil which splashes upon it being relied upon as sufficient for proper lubrication), it is liable to heat and wear. An ample supply of oil for the wrist pin is insured in the Buffalo engine by the attachment of a lipped cup thereto. This cup is continually filled with oil thrown back by the crank discs, and the lip prevents it from spilling out. The wrist pin is hollow and leads the oil to the interior of the crosshead, where it is fed to the bearings. A pocket or receptacle in the interior of the bed located on each side of the chamber near the top catches oil thrown from the crank discs, and feeds it to the main bearings through the grooves provided. After use on the various rubbing surfaces the oil is returned to the crank pit. A light polished hood and two side plates give a perfectly oil-tight construction, and being easily removable, afford ready accessibility to the various moving parts. A large sight feed lubricator takes care of the cylinder and valve chest. This engine is built for either belt or direct connection.



CANADIAN SOCIETY OF CIVIL ENGINEERS.

On December 20th at the ordinary meeting of the above society a paper on, "Rifle Ranges," by G. S. Maunsell, A.M. Can. Soc. C.E., was read. The author mentioned that there were in Canada about 100 military rifle ranges varying in number of targets from one to fifty-five. The great power of the modern rifle made it difficult to provide a perfectly safe rifle range. The extreme range of the Lee-Enfield bullet is between 3,500 and 4,000 yards; and the following thicknesses of materials are proof against bullets from this rifle: 24 inches of earth, not rammed; ¾-inch mild steel plate, 38 inches fir, and 24 inches oak. The paper dealt largely with the construction of ranges, shelters and frames, and was illustrated by several diagrams.

At the meeting on January 3rd, a paper on "Masonry Dams and Retaining Walls in General, Concrete Works, etc.," by Chas. Baillairge, M. Can. Soc. C.E., was read. It gave much interesting data gathered by the writer, partly in his own experience, regarding the strength and formation of dams and retaining walls, and the causes of failure in many cases. Some of these have already been cited by Mr. Baillairge in The Canadian Engineer.

The following have been admitted into the Canadian Society of Civil Engineers since September, 1900: As Members: Ashley B. Tower, 300 Broadway, New York; R. Bickerdike, jr., Montreal; A. J. Stevens, Moncton, N.B.; Joseph Rielle, Montreal.

As Associate Members: E. J. Boswell, Nelson, B.C.; W. A. Duff, Ottawa; F. L. Fellowes, Montreal; J. Hutcheon, Guelph, Ont.; J. D. Mackerras, Montreal; R. J. McD Parke, Toronto;

J. K. Scammell, St. John, N.B.; W. H. Shillinglaw, Brandon, Man., and T. H. Wiggins, Finch, Ont.

As Students: T. V. Anderson, Montreal; T. H. Byrne, W. B. Lindsay, E. C. Baker, B. Caldwell, W. Harty, jr., E. H. Lowe, E. H. Pense, W. B. Young, G. B. Johnson, H. L. Bucke, W. R. McConkey and J. A. Riddell, Kingston, Ont.; H. C. Grout, Winnipeg; F. E. Patterson, Montreal; L. Sherwood, Napanee, Ont.; W. A. Duff, Hamilton, Ont.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

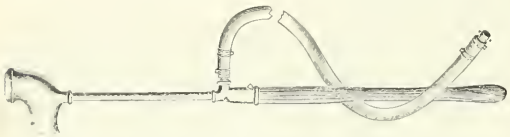
The monthly lectures given under the auspices of the C.A.S.E. in Toronto, are very successful. The attendance improves with each meeting. In November, A. M. Wickens gave a lecture on "Economy in the Engine Room." Last month Mr. Robb, of the Boiler Inspection and Insurance Co., lectured on "Practical Tests of Boilers." On Wednesday, January 16th, E. J. Philip will speak on "Electricity."

The association invites any person who is interested to attend these lectures, which are held on the third Wednesday of each month at Engineers' Hall, 61 Victoria street. The lectures will be kept up till May.

A. M. Wickens and Chas. Moseley have been elected delegates from the Toronto branches of the C.A.S.E. to the Toronto Technical School.

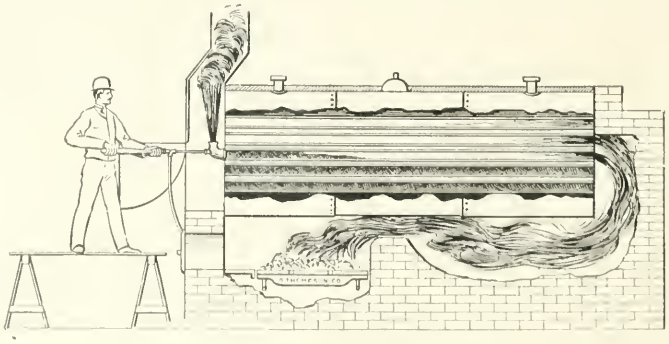
AN IMPROVED BOILER TUBE CLEANER.

The advantage of clean tubes in a boiler is admitted by all steam users. Soot is a non-conductor, and when it is permitted to remain in the tubes, heat is wasted. There are a great many appliances made for cleaning boiler tubes, but they do not always clean. Steam blowers are used to some extent, but a



great many object to blowing steam into a tube on account of the moisture, which is liable to make scale. Then a scraper has to be used. This is a slow process, but the only alternative, as the tubes must be cleaned and should be cleaned often.

The accompanying cuts show a form of cleaner that is not open to the objection of steam blowers, as there is no steam admitted to the tubes and it is claimed that it will do the work thoroughly.



By the use of a small amount of steam, which is first superheated by wire drawing through the apertures in the discharge tip, a vacuum is formed, drawing the soot from the tubes, and ejecting it with great velocity up the chimney and into the atmosphere, cleaning the tubes, flue and chimney. The Owen Sound Portland Cement Co., of Shallow Lake, Ont., says of this system: "Our engineer reports that the ejector works very well, and is giving excellent satisfaction. We are well pleased with it." Booklet "C," giving description of this cleaner can be obtained by addressing Richard Thompson & Co, Beard Building, Liberty street, New York.

ENGINEERS' CLUB OF TORONTO.

The informal opening last month of the new quarters of the Engineers' Club, of Toronto, was very successful. The rooms are in the Keystone Building, 96 King street West, and are most comfortable and well equipped. There is a good-sized reading-room, stocked with technical literature, a smoking-room, coat room, and lavatory; and a large lecture room capable of accommodating over 200. This has a lecture platform and a solid state blackboard, about 15 x 5 feet, for diagrams and illustrations.

At the regular meeting on the 19th December, A. B. Lambe, Jr., of the Canadian General Electric Co., gave an interesting talk on water-powers. In the absence of the president, Kivas Tully, W. T. Jennings occupied the chair. The lecturer gave an account of the various systems of water motors, such as the old bucket engines, undershot and overshot wheels, the hydraulic ram, the vertical and horizontal turbines, etc., with an account of the special adaptations made in various countries to suit local conditions. A discussion followed, in which Messrs. Keating, Jennings, McDougall, Rosebrugh, Duckworth and Chipman took part. The discussion drifted to the question of the electrical transmission of water-power. Mr. Keating said the first question in transmitting power to such places as Toronto from distant water-powers, was, at what price can it be delivered in the city? and the next was, can the users depend on uninterrupted supply? Referring to the causes of interruptions, Mr. Jennings mentioned an interesting case on the Metropolitan Railway, running north out of Toronto, where there were mysterious leakages of current which were afterwards found to come from straws blown from hay wagons, these straws lodging on the wires and causing discharges in the air in damp weather, while some leakages were also found to be due to the leaves and twigs of trees, which sagged down on the wires in wet weather, and caused air discharges. The voltage there was 10,000. Mr. Rosebrugh observed that when the voltage reached, or exceeded, 40,000, insulation was difficult and air discharges were likely to take place in certain conditions of the atmosphere. Mr. Lambe remarked that one trouble was the destruction of the porcelain insulators by the small boy, and it was a good practice to paint the white insulators a neutral tint, so they could not form so attractive a target.

On the afternoon of December 31st, the members joined the Architects' Association, of Ontario—whose reading-room adjoins that of the Engineers' Club—in a lunch and social meeting for half an hour, to commemorate the closing of the century.

The annual meeting of the club was held on Tuesday evening, January 8th, 1901. The chair was taken by Principal Galbraith, of the School of Practical Science, vice president, in the absence of Kivas Tully, president, who was ill.

W. G McN Thompson, St. Catharines, Ont., and J. Newton Ker, Ottawa, Ont., were elected members. Reports were read from the secretary, treasurer, finance committee and library committee, also a verbal report re furnishing of the club rooms. The financial statement was considered very satisfactory. It is estimated that there will be no deficit, notwithstanding the expense of installing the club in its new quarters.

The following were elected as officers for the year 1901: President, A. L. Hertzberg, C.P.R., Union Station, vice-president, Major H. A. Gray, Engineer Public Works of Canada, Lake District; secretary, Willis Chipman, 103 Bay street; treasurer, C. M. Canniff, 100 King street West; directors, James McDougall, Engineer, County of York, Court House; T. R. Rosebrugh, Lecturer on Electricity, School of Practical Science; Cecil B. Smith, City Engineers' Department, City Hall, Toronto. A vote of thanks was tendered to Mr. Tully, the retiring president.

The topic for discussion for the evening was "What Are the Essential Qualities in a Specification for Portland Cement." The discussion on this topic was not finished, but will be concluded at a special meeting on January 17th. A business luncheon will be held on January 31st.

PROF. GALBRAITH, PRINCIPAL SCHOOL OF PRACTICAL SCIENCE.

It must have been a proud moment to Prof. John Galbraith, when he sat down among nearly 400 of his students, and undergraduates, friends and fellow-educationists, to the banquet given him last month, on the 21st anniversary of his connection with the School of Practical Science, Toronto, of which he has been since 1878 the honored principal. It was one of those occasions, the recollection of which must go far to compensate a man for the worries and anxieties that are the sure inheritance of a position such as his. We regret we are unable to give this month a report of the very successful banquet, but there are many of our readers who can heartily endorse the opinion of President Loudon, of Toronto University, who said: "Prof. Galbraith from the first won on his merits. He was an accomplished engineer, a good mathematician, an all-round scholar, and, above all, a gentleman worthy to be ranked with the Shanlys and the Keelers, with Gzowski and Fleming, and many others, who, like them, had adorned and advanced the engineering profession in Canada." In reply to the toast of his health, Prof. Galbraith gave utterance to some sentiments on the spirit of scientific education, to which we shall have the pleasure of quoting in another number.

MARINE ENGINEERS' ASSOCIATION.

At the annual meeting of Toronto Council, No. 1, National Association Marine Engineers of Canada, held in the Confederation Life building, Toronto, the following officers were elected for 1901: Hon. President O. P. St. John; president, Wm. Harwood; 1st vice president, Thomas Crossley; 2nd vice president, James A. Findlay; Council, Oscar Flummerfelt; St. Catharines; Samuel Beatty, Collingwood; Louis Marchand, Montreal; P. W. Lyon, Barrie; J. E. Kane, Kingston; financial secretary, S. A. Mills; treasurer, Harry Parker; recording secretary, J. Summers Adam; conductor, James Currie; doorkeeper, Arthur Abbey; auditors, D. L. Foley and A. J. Woodward. After the elections Mr. Miller, of the American School of Correspondence, delivered a very interesting address on square and cube root. It was reported that branches would be formed at Kingston, Collingwood and other places.

D. L. Foley and S. A. Mills since the above meeting went to Collingwood and organized a branch of the Marine Engineers' Association. The new branch starts with a good number of charter members, the engineers all being enthusiastic over the amalgamation of the Marine Engineers' Association from St. John, N.B., to Vancouver, B.C. Collingwood branch will be known as No. 3, and the officers elected for the ensuing year are: President, D. McQuade; 1st vice-president, J. W. Aston; 2nd vice-president, J. T. Smith; secretary, Joseph Aston; treasurer, W. Whepps; Council, E. X. Myler, S. Beatty, Frank Cleeland, Sanford Donnelly, W. Harman; conductor, J. Grierson; doorkeeper, J. Hicks; auditors, D. McQuade, J. T. Smith.

JAMES ROBERTSON.

The death of James Robertson, at his home in Montreal, December 18th, removes a very prominent figure from among the manufacturers of Canada. Deceased was born in Sterlingshire, Scotland, in 1831, and came to Canada in 1857 to establish a Canadian branch of the firm of Alexander, Ferguson & Lonnie, of Glasgow, in whose business he had worked himself up to be a partner. After being in charge of this for five years, and meantime having saved £4,000, he bought out his principals and began on his own account as a manufacturer of lead pipes and dealer in plumbers' supplies. The business developed steadily and new branches were added to the lines manufactured, till at the time of his death the James Robertson Co. were manufacturers of lead pipe, shot, babbitt metal, plumbers' supplies, saws, oils, colors, varnishes, japans and mixed paints, with factories and warehouses in Montreal, Toronto, St. John, and Baltimore, Md., and a warehouse in Winnipeg. Mr. Robertson was a man of strong religious convictions and high business integrity. What he undertook he carried out, though cautious in new ventures. He was fair and generous in his dealings with employees. Though the business was a joint-stock company it is in the control of his family, of whom the four sons, James, John, Charles and Alexander are actively carrying on the operations of the extensive works he founded.

—Charles A. Olson, of the Crane Co., Chicago, formerly superintendent for the Westinghouse Co., at St. Petersburg, Russia, was a recent visitor at the International Correspondence Schools, Scranton, Pa. Mr. Olson stated that a number of men in his employ in Russia were students of the schools. These schools report students in over one hundred foreign countries.

—Columbia University recently announced that students desiring it can now take a course in motor vehicle construction. In adding such a course the faculty say that the motor vehicle has now become such a factor in commercial and private use that it is deemed as essential that a mechanical engineer should now be as well posted in motor vehicle construction as in marine, stationary or locomotive engineering. Some time ago the International Correspondence Schools, Scranton, Pa. announced a course in gas, gasoline and oil engines, in which special attention is given to the application of these engines to motor vehicles.

THE NEW MIDLAND SMELTER.

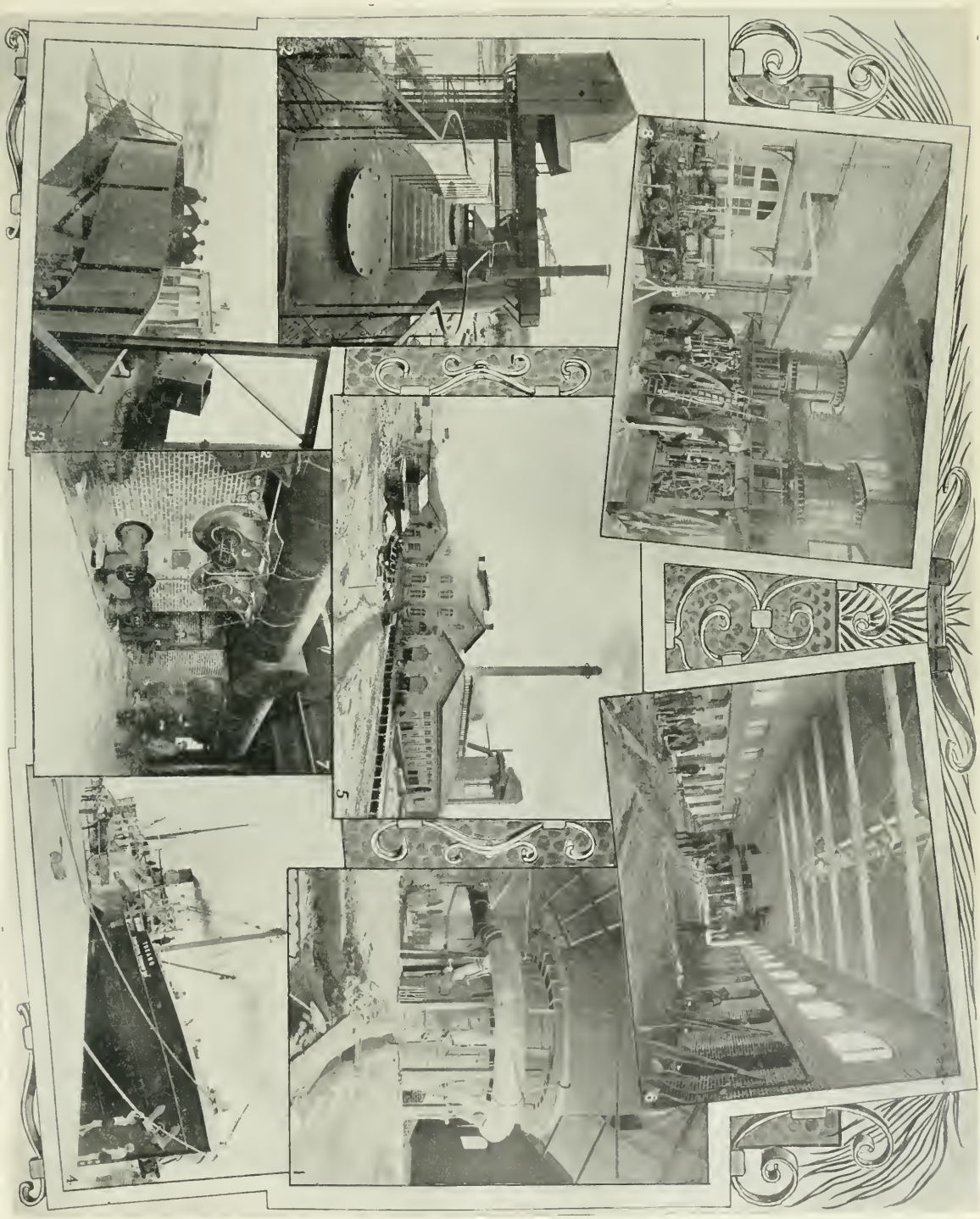
On December 18th the Canada Iron Furnace Co. officially opened their new blast furnace plant at Midland, Ont. The company is composed of gentlemen well known in the iron trade; on the directorate are the Hon. T. Guilford, of Buffalo, N.Y.; P. H. Griffin, of Buffalo, N.Y.; A. F. Gault, of Montreal, Que.; G. Gudewill, of Gudewill & Bucknell, of New York and London, and the Westinghouse A. B. Co., E. V. Douglas, of Philadelphia, and last but not least, F. H. Clergue, of Sault Ste. Marie, who is performing miracles in developing the immense natural resources of the Algoma District and New Ontario. The smelter is the work of Canadian engineers, and the ore to be used will be Canadian. The Midland furnace has a capacity of 150 tons of pig iron per day, and will add upwards of 55,000 tons per annum to the production of pig iron; the product of Canadian ores and labor. This output alone equals what was the entire output of Canada five years ago, and, added to the production expected from the Sydney works and the proposed works at Sault Ste. Marie, will, within the next year, put the Canadian iron industry upon a par with that of Sweden, a country that has taken six hundred years of steady work to bring its trade to its present proportions in point of tonnage.

Midland Smelter—View of Works from Harbor.

The election of Mr. Douglas, of Philadelphia, and Mr. Clergue of Sault Ste. Marie to the board will form a connecting link between the Michipicoten mines and the iron and steel works to be erected at Sault Ste. Marie. The total output of pig iron last year in Ontario was 64,749 tons, but the Midland smelter will produce almost as much alone. The output being almost wholly the product of Canadian ore; this means much to Ontario miners producing the ore, and to the railroads and steamship lines employed in the carrying of it. The company's extensive works at Radnor Forges, Que., are well known to our readers. Here it turns out a special quality of iron ranked by competent engineers the world over as superior even to the best Swedish iron, and being of such a superior class it has reached the markets of the United States, Great Britain and the European continent, as far east even as Budapest. Such well known manufacturers as the Creusot Works, of France, and Krupp, of Germany, were large consumers of Radnor Forge iron, while Austria, also, took a considerable quantity. The company chose Midland for the site of their smelter for the reason that the geographical position of Midland assures to it very great advantages as a shipping point for both east and west; and moreover its close proximity to the Lake Superior mining districts (the ores of which the company requires for the production of high class iron) gives a furnace situated at that point a most decided advantage over any of its competitors, either in Canada or the eastern United States. It is safe to say that steamships carrying ore to Midland can make two trips to one that can be accomplished by steamers conveying ore to furnaces at points further east, the latter having to carry the ore from Lake Superior through Lake Huron, Lake St. Clair, the Detroit river, Lake Erie, and the Welland canal, the distance being naturally much greater in the latter case, and in addition to this the steamers have to proceed at certain points under slow speed. The chief consumers of iron in Ontario are situated within a radius of 150 miles from Midland, and the Grand Trunk system reaches almost, if not all, the consuming points. From Midland east to Montreal the route is said to be one mile shorter than by way of Parry Sound, and very much shorter than from other Georgian Bay ports. A little straightening of the railway line will make the Midland route shorter still, and already it is fast becoming a competitor for the grain trade with Buffalo. The new elevators of the Grand Trunk Railway handled through Midland last year as much wheat as did the Parry Sound elevators. The Canada Iron Furnace Company have erected most commodious wharves in connection with their works, and during the past season vessels drawing from 18 to 21.6 feet of water have been able to discharge their cargoes on the docks of the company right alongside the smelter.

The following comparative distances will show the superiority of the Midland route over that via Buffalo: Chicago to Montreal, via Midland, 962 miles; Chicago to New York via Buffalo, 1,320 miles; in favor of Midland, 367 miles. Duluth to Montreal via Midland, 1,057 miles; Duluth to New York via Buffalo, 1,437 miles; in favor of Midland, 380 miles.

The Midland smelter works were all planned and installed by a Canadian engineer, John J. Drummond, and according to most competent judges the work has been splendidly carried out. The company have entered into an alliance with F. H. Clergue, who, at the head of a powerful syndicate of capitalists at Sault Ste. Marie, had discovered and was opening up the now famous "Helen" mine at Michipicoten, to be followed later by the discovery and development of the Josephine and other equally important mines in that district. He has undertaken to supply ore, and so successfully has this



Views of the Midland Smelter.

arrangement been inaugurated that before the close of navigation of 1900, upwards of $250,000 worth of Canadian ore of a quality equal to anything obtainable on the continent was stacked on the company's dock at the smelter. Four steamers were employed until the close of navigation in carrying "Helen Mine" ore from Michipicoten harbor to Midland—the "Monkshaven," the "Leafield," the "Faliki," and the "Theano"—and combined they delivered only sufficient to supply the requirements of the smelter for the winter months. The company at present are only capitalized at one million dollars; but this will be increased from time to time as the extension of the works may call for more capital.

The directors to whom the active management in Canada is entrusted are: Geo. E. Drummond, J. F. McCall, and Thos. J. Drummond, all of the well-known firm of Drummond, McCall & Co., a firm that for twenty years has had perhaps as close a connection with the development of the iron and steel industries in Canada, as any other single concern. As manufacturers the Messrs. Drummond & McCall are closely identified with such iron consuming enterprises as the Montreal Pipe Foundry Co., with works at Lachine, Que., and Londonderry, N.S., and the Montreal Car Wheel Co., also with works at Lachine, Que. John J. Drummond is the company's general superintendent of works. The buildings and all machinery rest on solid concrete foundations. The works are directly across the harbor from Midland, and are erected upon the extensive property of the company, with plenty of room for future development. There is sufficient spare space being left to accommodate additional iron and steel works of the most extensive character, and wharfage accommodation, finished and in course of construction, ample to serve a considerable number of vessels. The water at the docks is, at present 21 feet 6 inches deep.

Ground was broken on June 10, 1899. At that time a large portion of the property was swamp, with a good hard-pan bottom. Immediately in the rear of the beach line was a large hill and this was practically cut down and the earth used for the purpose of filling in and straightening the water front. There were a number of difficulties met with at the start, but in spite of these the plant was installed in splendid shape. The fires were started by one of the directors, Geo. Gudewill, of New York, and on Tuesday, December 4, at 4.30 in the morning the first iron was run off, and the first shipment secured by Edward Gurney, of Toronto, for use in his works. The output will be about 150 tons a day, and the company at present employs some 200 hands. An inspection of the works reveals the substantial character of the plant. The furnace, 64 by 13 feet, with hoist water-jackets, and all fittings, is modern in every respect. The elevator for hoisting stock to the top of the furnace consists of heavy cast-iron columns, resting on a solid concrete foundation. The entire framework is practically indestructible. Apart from the two sections devoted to the elevator cages there is a third fitted up with stairs, to enable the workmen to ascend and descend without using the elevator. The top is fitted with safety floors and other devices for the purpose of protecting the men against accident. The steam hoisting engine is of the Crane type, and rests on a concrete foundation capped with a massive slab of granite. There are three hot blast stoves, 10 feet diameter, by 66 feet high, known as two-pass stoves, resting upon a substantial stone foundation, laid in concrete. The furnace casthouse is 40 feet wide by 165 feet long, the floor of which is five feet above yard level. The walls are entirely of brick, heavily built,

Blast Furnace—Midland no. 1.

23 feet 6 inches high, and the foundations are of heavy concrete.

The boiler plant consists of eight large cylindrical boilers, in batteries of two each, six of which are ample for the purpose of supplying all steam requirements, leaving two spare boilers, so that the plant can be kept in a state of thorough efficiency. The boiler house is of iron columns with a steel roof. Between the columns is built in with brickwork, and the boiler house is erected immediately adjoining the engine room, so that the engineer on duty can at all times have the boilers under his eye. The engine-house is a brick structure with fire-proof roofing, and provided with steel beams for the purpose of handling any portion of the machinery situated in the building. There are two powerful blowing engines, made by the Columbus Machinery Company. The steam cylinders are 34 inches and the blowing tubes or wind cylinders, 72 inches in diameter, 4-foot stroke. Each one can supply sufficient blast for the furnace. The engines are set in massive concrete foundations, capped with granite, while each engine is provided with a gallery, railed in, to permit the engineers to get at all parts in safety. The engines are supplied with patent

water heaters. The engine-room is fitted with three modern duplex steam pumps of the Gordon type, cylinders 16 by 12 by 18 inches, and of capacity sufficient for boilers and fire purposes. These pumps connect with a large tank situated on the hill in the rear of the furnace plant. This latter, which is entirely built of steel, is 40-ft. high, 72-ft. above the bay level, and has a capacity of 30,000 gallons of water. There is also a hand engine on the grounds. The chimney is built of steel, 10 feet in diameter, and 170 feet high. The chimney foundation is of stone, 20 feet deep, and is exceptionally strong.

The workshop is a brick building 30 by 60 feet. One end contains the blacksmith shop, in which is situated a locomotive-type boiler with engine for providing power for the shops, and for heating them in winter if the furnace should shut down. The remainder of the building is used for a machine and carpenter shop, and for general repairs, and in the carpenter shop are the necessary wood-working machines, such as sawtable, jig-saw and buzz-planer. The machine shop is also equipped with the usual tools for furnace use, pipe cutting and screwing machines, lathe and drilling machines, and iron sawing machines for cutting samples.

Temporary offices for the officials have been provided at the works, but next season the company proposes to build handsome general offices in keeping with the works, which will contain a fully equipped chemical laboratory in addition to the necessary public and private offices, directors' board room, etc. The company also intend in the near future to erect for their employees a club house fitted out with a reading room amply stocked with the current literature, also a room where the men can take their meals in comfort. A first-class ore discharging apparatus is to be erected by the company this winter, a plant that will enable them to discharge at a speed equal to that at any of the American ore ports on inland waters. An electric plant is also being installed. The erection of ore stock sheds is also contemplated next season. The grounds around the works are fitted out with railway switches so that materials can be handled with economy. These switches connect with the Grand Trunk Railway.

The ore from the Helen Mine, used by the company, is a rich, brown hematite, soft and easily worked, and has no superior for a high-class foundry iron. Mr. Drummond, the general superintendent, is justly proud of the staff he has gathered around him. Each head of a department is a specialist in his line, and the success that has attended the working of the smelter during the short time it has been in operation, is the best evidence of the capability of the staff. In its investigations for limestone for flux and also for stone for foundation purposes the company came upon a splendid limestone property, of 138 acres, about two miles from the furnace, and furnishing an unlimited quantity of stone. The land gradually rises from the water, so that stone can be delivered to the vessels by gravity. At the furnace wharf a gyratory stone crusher has been erected for crushing the limestone for fluxing purposes. This is complete with its own steam plar

GENERAL ENGINEERING CO. VS. AMERICAN STOKER CO.

The above case, referred to in previous issues, in which the validity of the Jones' underfeed stoker patent was called in question, came up for judgment in the Supreme Court, at Ottawa, last month. It will be remembered that the American Stoker Co., of New York, sold an equipment of underfeed mechanical stokers to the Dominion Cotton Mills Co., of Montreal, whereupon the General Engineering Co., of Toronto, owners of the Jones' patent, charged the American company with infringement of its patent. The General Engineering Co. won, but the American Stoker Co. attacked the Jones' patents, under section 8 of the patent act, claiming that when a foreign patent expired, the Canadian patent also became void, the Jones' patent in Italy having in this case lapsed. In the judgment given last month, the Supreme Court holds that section 8 of the act should not be construed to void a Canadian patent in that way. This settles the ownership of the Jones' patents in favor of the General Engineering Co., whose case was fought with great ability by the legal firm of Rowan & Ross, Toronto. Following this important judgment, a similar action is being carried on in the Superior Court of New York to determine the validity of the Jones' patents in the United States.

LT.-COL. GIROUARD,

son of Justice Girouard, of the Supreme Court of Canada, is now director-general of the Imperial Military Railways of South Africa. He did his first work as a railway engineer on the C.P.R., and afterwards studied military engineering at Woolwich. He gained great distinction in building the military railway for Lord Kitchener in the Soudan campaign, his subsequent career being well known to our readers.

M. J. KENNEDY,

successor to Duncan McDonald, as traffic superintendent of the Montreal Street Railway, is a native of Montreal, and began work with the company as a car conductor. He was appointed inspector, or road master, of the eastern division in 1892, and chief inspector, or assistant superintendent, in 1895. Mr. McDonald, who, as already mentioned, is now consulting superintendent of the General Traction Co. of Paris, France, was tendered a banquet on leaving Montreal last month to take his new position.

Industrial Notes.

New Glasgow, N.S., ratepayers have voted $3,000 towards putting in a fire alarm system.

The contract for dredging the entrance to the Sault canal has been awarded to James Whelan, of Port Arthur.

Willis Chipman, C.E., Toronto, is preparing plans for the new filter beds of the London, Ont., sewage system.

The capital of the Record Foundry and Machine Co., Moncton, N.B., has been increased from $100,000 to $250,000.

The Alumni Association of Toronto University is considering a proposal to raise money for a memorial hall to cost $25,000, and seat 1,500 people.

The Robb Engineering Co., Ltd., have received an order from the Dominion Iron and Steel Co. for a 100-h.p. Mumford standard boiler, this making the eleventh of this type shipped to the same company.

B. S. Colburn, F. C. McMath and Geo. F. Porter, Detroit, Mich., are applying for incorporation as the Canadian Bridge Co., Ltd., to manufacture bridges, etc. Capital stock, $250,000; head office, Walkerville, Ont.

R. L. F. Strathy, who for the last eleven years has been engaged in wire fence manufacturing in the Eastern Provinces, and who was about to form a company at Welland, is now in Owen Sound, proposing to start a wire fencing works there.

Henri Bourassa, Theotime Bonhomme, Henri Vincent, Samuel Lauzon, Seraphin Bock, Philemon de Varennes, Papineauville, Que., are applying for incorporation as the Papineauville Lumber Company; capital, $50,000; headquarters at Papineauville.

The Montreal Cotton Co. will erect another mill at Valleyfield, Que., with a capacity of about 50,000 spindles. The new building will be erected on the Buntin property, adjacent to the main factories. The contract has been let and the cotton machinery is being ordered in England.

The contract for the iron bridge over the Yamaska river has been awarded to the Dominion Bridge Company, Montreal, and work will be commenced shortly. It is the intention of the South Shore Railway Company to prolong its line from Yamaska to Levis by way of Nicolet.

A number of prominent contractors are preparing estimates for the harbor works at Sorel. The work is estimated to cost about half a million dollars, and consists of dredging and cribwork to form a harbor to accommodate the traffic which it is expected will be attracted to Sorel by the erection of elevators by the Rutland and Vermont railway.

Application will be made to the Parliament of Canada by W. C. Edwards, J. A. Cameron, Rockland, Ont.; J. C. Edwards, R. G. C. Edwards, Hiram Robinson, H. K. Egan and R. L. Blackburn, Ottawa, for an act to incorporate the Ottawa and Hull Power and Manufacturing Company, to manufacture lumber, paper, pulp, woolen and cotton goods and chemicals; to operate mines and develop water power and electricity, etc.

The Syracuse Smelting Works, Montreal, have made the largest importation of aluminum ever brought into Canada in one shipment, and they are now selling it at special prices. Aluminum is used at the present time extensively for making all kinds of aluminum castings as well as a flux in iron and steel. The Syracuse Smelting Works also use it in their best grade of babbitt metal, which is called "Aluminum Genuine Babbitt," and is claimed to be the best boring metal on the market.

The Goldie & McCulloch Co., Ltd., Galt, Ont., are doing a large business with the Model gas or gasolene engine. Among recent sales are: Geo. McMurray, St. James Park; Robt. Mosgrove, Bluevale; A. S. Geiger, Breslau; Edward Provost, Acton Vale, Que. They also have orders for five Ideal steam engines from the Dominion Coal Co. Glace Bay, N.S., two of the same type for the Kingston Asylum, besides others. The Maple Leaf Saw Works at Galt are placing in their factory a tandem compound Wheelock engine made by the Goldie & McCulloch Co.

The Canada Foundry Company have decided to construct a large machine shop and foundry next spring.

The Coldbrook Rolling Mills, St. John, N.B., were burned December 19th. Loss about $100,000.

Parry Sound, Ont., will spend $26,500 in improving its water service and taking over the electric light system.

It is proposed at Ottawa to start a bridge and structural steel works. The promoters are Ottawa and Montreal men.

J. R. Simpson is asking Hastings, Ont., for a bonus of $7,000, a free site, water-power, and exemption from taxes, to establish a furniture factory in that village.

It is proposed at Midland to raise $75,000 for a system of waterworks, and $5,000 for a sewer on the main street. A proposal to purchase the town electric light plant will also be considered.

The Thos. Forrester Co., of Montreal, wish to establish a factory in Carleton Place for weaving brass and copper wire cloth. They promise, for certain privileges, to employ fifty hands.

Daniel Knechtel, J. S. Knechtel, J. E. Knechtel, J. H. Adams, and H. H. Miller, Hanover, Ont., have been incorporated as the Hanover Portland Cement Company; capital, $150,000; head office, Hanover.

The Bank of Montreal is to have a new building, in Montreal, to cost from $750,000 to $1,000,000. It has purchased the site of the Canada Paper Co.'s warehouse, Craig street, as part of the ground, and that company will rebuild elsewhere.

F. B. Chapin, E. W. Langley, and Donald Clark, Toronto; William McVittie, Sudbury, and Frank B. Hubbell, New York, were recently incorporated as the Blanche River Pulp and Paper Company; capital, $1,000,000; head office, Toronto.

Barkey & Phoenix have bought out the Fleury foundry business at Stouffville, Ont., and have put in new machinery, and otherwise reorganized the establishment. Both members of the new firm are comparatively young men, and they will make a specialty of agricultural engines and boilers, and other agricultural machinery.

Henry G. Goulding, late chief of the Kingston fire brigade, has joined C. Selby, of the late firm of Selby, Raney & Co., and will carry on the business formerly known as the Kingston Foundry Co. The new firm will carry on a general foundry business, making a specialty of marine work. John Elmer succeeds Mr. Goulding as chief of the fire brigade.

James L. Robertson & Sons, New York, give notice in our advertising columns that they have appointed E. J. Philip, of 43 Wellington street East, Toronto, agent for their famous "Eureka," packing. This concern was established in 1878, and manufacture many appliances of interest to steam users, and have a trade all over the world for their various engineering specialties.

The annual general meeting of the Montreal Metal and Hardware Merchants' and Manufacturers' Association was held December 7th. The election of officers resulted as follows: Pres., W. W. Near; vice-pres., James Davidson; treas., J. C. McCormick; directors, George Caverhill, F. H. Hopkins, James W. Pyke, and W. S. Leslie. G. E. Drummond was chosen as the association's representative on the council of the Board of Trade.

J. A. Burgess, Bradford, Ont.; C. G. Harston, George Dunstan, George Ritchie, and W. W. Strathy, Toronto, have been incorporated as the Burgess Gas Process Company, to purchase the invention of J. A. Burgess for purifying, enriching and improving gas, and to purchase, manufacture and sell machinery therefor. Capital, $100,000; head office, Toronto.

Owing to the rapid increase of students the American School of Correspondence, Boston, Mass., has enlarged its staff by the addition of four new instructors, all of whom are teachers at the Massachusetts Institute of Technology. The American school is thus making it possible for the intelligent mechanic to put himself in touch with the same grade of construction as is open to those who can afford a university course. The Canadian headquarters of this school are at Elliott House, Toronto, under the direction of R. R. Miller.

The Canadian Pacific are constructing in their Hochelaga shops 20 new freight engines.

The Canadian Northern Elevator Co. are building an elevator at Gilbert Plains, Man.

Hay Bros., foundry, Portage la Prairie, have dissolved, Ed. Hay carrying on the business.

The Dominion Government is building an extensive breakwater at Antigonish, to cost $27,000.

The new Farmers' Co-operative Pork Packing Co. at Brantford, has commenced operations with 30 hands at work.

J. Clarke & Son, machinery dealers, Fredericton, N.B., have purchased the New Brunswick foundry for about $15,000.

The Huntsville Lumber Co. is building a factory for woodenware of different kinds, such as pails, tubs, boxes, etc.

The city of St. Catharines will vote on the 21st inst. on a by-law to loan $30,000 to the National Iron Works Co., who proposes to establish an iron and brass foundry there.

It is reported that a large U.S. locomotive establishment proposes to start branch works in one of the Maritime Provinces, probably Nova Scotia. No particulars are given.

The Lithographed Tin and Can Company; capital, $200,000, for lithographing, decorating, enameling, japanning and printing on tin or other sheet metals, is applying for incorporation with headquarters at Toronto.

W. J. Poupore, contractor, Montreal, has taken an action against the Lachine Hydraulic Co., for $86,463, which he claims to be due him in connection with the construction of the company's works near Lachine.

Peter Lyall & Son, contractors, Montreal, are suing the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, for $100,000 claimed on a sub-contract for the construction of the Chambly dam, for which the defendants were contractors.

A Dominion charter is being applied for to incorporate the Clergue Iron & Nickel Steel Co., of Canada, to mine and manufacture iron, steel and nickel, to construct furnaces, rolling mills, chemical and other works, and to build steamships and railways.

The American Cereal Company, of Akron, Ohio, and Cedar Rapids, Iowa, have secured an option on the Dickson Company water-power at Peterborough, Ont., and proposes to erect a branch mill there, at which six to eight hundred men would be employed.

The town of Wingham has voted a loan of $17,000 to the Galt & Bullock Iron Works Co. in case it locates its proposed works there. The company is composed of John Galt, C.E., late city engineer of Ottawa, and W. C. Bullock, late of the Canada Foundry Co., Toronto, and others, and proposes to manufacture specialties in waterworks supplies, etc.

A despatch from St. John, N.B., states that after an interview with the New Brunswick Government, Chas. Burrill and B. F. Pearson, directors of the Dominion Iron and Steel Company, announced that within a year they would be building steel ships at St. John and Halifax. Five million dollars will be invested in the two plants. Two thousand to three thousand hands will be employed each year. The Provincial Government is expected to grant a subsidy.

The Syracuse Smelting Works, Montreal, have placed on the Canadian market the Columbia Phosphor Tin, of which they are the sole makers in Canada. It has been a study of metallurgists for many years to introduce phosphorus into the molten metal, and the largest users of this material have complimented this firm on getting a higher percentage of phosphorus into the tin of any such alloy made to-day. Owing to their success in this they are exporting the material all over the civilized world where phosphor bronze castings are made. They also furnish formulas showing how to make any desired grade of phosphor bronze with Columbia phosphor tin as a flux. In old metal there is nothing better known to-day, as it purifies the metal thoroughly. Old copper can be used as well as new in making phosphor bronze castings, as it has such an effect on metal that a pot of brass can cool by adding a very small quantity of phosphor tin, and it will increase its fluidity. It is often found by parties making brass castings that they cannot always get the desired heat upon a metal, but by adding a small quantity of this it will increase its fluidity. The Syracuse smelting works are experimenting on a new alloy to phosphorize spelter, and if this proves successful it will no doubt have a large sale.

The experiments recently made by the Toronto postoffice in collecting and delivering mails for the district offices of the city by motor carriages having proved successful, a further step is being taken in the same direction by using motor vehicles for collecting from the street letter boxes. The present method is to collect by postman on foot, but a number of light 4-wheel motor carriages are being built with a box for the mail in front and a seat for the driver at the rear. If the vehicle is a success it will greatly facilitate the quick delivery of mail matter.

The spruce lands at Musquash, N.B., formerly known as Inglewood manor, and comprising 36,000 acres, are being sold to a syndicate composed of Charles Burrill, Weymouth; Benjamin F. Pearson, Halifax; Robert McKay, Montreal; W. H. Rowley, Ottawa; Franklin Stetson, George W. Jones, George McAvity and others, who propose to vest the property in the Lancaster Pulp and Paper Company, a corporation incorporated at the last session of the New Brunswick Legislature, and to erect a sulphite mill for the manufacture of pulp and a paper mill for the highest grade of paper. The spruce timber along the Bay of Fundy is highly spoken of as a pulp wood by experts.

The proposed works of the Cramps, at Collingwood, of which mention was made last year, seem now likely to go ahead, as the Cramp-Ontario Steel Co. is now being advertised for flotation, with a capital of $5,000,000. This is not a Canadian branch of the Cramp Shipbuilding Co., as many suppose, though two members of the Cramp family are on the directorate. These are Charles D. Cramp, late supervisor of the Cramp works, who is president of the projected concern, and Wm. M. Cramp, late vice-president of the Wm. Cramp & Sons Ship and Engine Building Co. Among the other directors are F. H. Clergue and Sir Charles Hibbert Tupper. The company propose to establish open-hearth steel furnaces at Collingwood, and to design their plant for the production of nickel and nickel steel.

Railway Matters.

The C.P.R. will extend a branch railway into the Lardeau country early in the year.

The Dutton extension of the Detroit River and Lake Erie Railway will soon be completed.

The Quebec Northern Railway will ask the Provincial Government for authority to construct a railway between Hull and James Bay.

It is expected that the International bridge across the Rainy River at the junction of the Beaudette will be finished and ready for traffic early next summer.

The South Ontario Pacific Railway Co., the Guelph Junction Railway, and the B.C. Southern Railway Co., are asking an extension of time for constructing their lines.

Application is being made by the Windsor, Essex and Chatham Railway Co. for incorporation to construct a railway from Windsor, Ont., to Leamington, Ont., and Chatham, Ont.

The Great Northwest Central Railway Company is applying for an act to extend the time within which it may construct its railways, and making Montreal the head office of the company.

The C.P.R. is applying for an act authorizing them to construct and operate a railway from Stonewall, Man., north west to a point on the east shore of Lake Manitoba near Marsh Point.

R. S. Logan, formerly secretary to Charles M. Hays, has been appointed assistant to the general manager of the Grand Trunk. A portrait and sketch of Mr. Logan will appear in next issue.

The contract for the new C.P.R. bridge over the Red River at Winnipeg has been awarded. It will cost about $150,000. Its total length will be 772 feet, with four spans of 120 feet each. The swing span will have two clear openings of 114 feet each.

At the annual meeting of the Temiscouata Railway Company, held at Quebec, on December 6th, F. Grundy was elected president, and the general manager, Mr Crockett, announced that he was obliged to resign his position owing to other business; but finally consented to act as manager until the end of the season.

L. H. Wheaton, of the Halifax and Yarmouth Ry., Yarmouth, N.S., has been appointed a member of one of the committees of the Association of Railway Superintendents of Bridges and Buildings.

Application is being made by the Vancouver, Westminster, Northern and Yukon Railway Company, for an extension of time, and for power to run north to Dawson City, thence along the Yukon River to the boundary of Alaska.

The Harbor, Bridge and Railway Company, of St. John, N.B., are applying for incorporation to erect a railway and general traffic bridge across the harbor of St. John, connecting the northern end of the city of St. John with the western end.

William Wainwright, assistant general manager of the G.T.R. system, has been appointed general assistant and controller, a position which gives him the practical supervision of the company's finances. Mr. Wainwright has been in the service of the Grand Trunk since 1862.

Application is being made at Ottawa to incorporate a company to build a railway from Galetta on the C.A.R. north across the Ottawa river, to a point on the Pontiac and Pacific Junction between Quyon and Shawville, with power to extend to Arnprior, Perkins, Fraser and Burbidge.

The Quebec Northern Railway Company is applying for incorporation to construct a railway from Hull, Que., to a point near the northern boundary of the counties of Montcalm or Joliette, and thence, in a northerly direction to a point at or near the mouth of the East Main River on James Bay.

The terminal facilities of the G.T.R. at Portland, Me., described in a former number of The Canadian Engineer, are found to be insufficient and will now be increased by new wharves and by another elevator of a million bushels capacity and costing $300,000.

A charter is asked for a railway to run from some point on the Ottawa river, in Pontiac county, in or between the township of Onslow and the mouth of the Dumoine river, by the most feasible route to the district drained by the Coulonge, Black and Dumoine rivers, and northerly to James Bay.

Work on the location survey of the Canadian Northern Railway in Saskatchewan is being pushed. One party of engineers is working westward from Red Deer river, while the other is working eastwards from Prince Albert. These parties will meet in a few weeks, which will complete the survey to Prince Albert.

David McNicoll, Thos. Tait, Montreal, Que.; Harry Abbott and Geo. McL. Brown, Vancouver, B.C., are applying for incorporation under the name of the Kootenay and Arrowhead Railway Co., to construct and operate a railway from Arrowhead, B.C., via Trout Lake or Duncan River to some point at the north end of Kootenay Lake.

The Globe's Ottawa correspondent reports: Mackenzie and Mann propose to construct a line from Winnipeg to Quebec city to the north of the country traversed by the Canadian Pacific Railway. Surveys have been made, and the Ontario Government has been approached for aid. The proposed road will parallel the C.P.R. from Winnipeg to the Lake of the Woods, thence east to the Abittibi river, and ascend the river valley to Lake Abittibi, turning south through the Temiscamingue district and thence to Quebec. Reports from the exploration parties indicate that the road will pass through a fertile belt, suitable for grazing and vegetable growth, with chances of mineral development. We are informed that the above is a premature statement of a project that has not yet taken shape. The portion that has so far taken shape in the railway scheme by Mackenzie and Mann, which may yet span the continent, is the line from Port Arthur to Prince Albert, a distance of about 1,000 miles, which is now so far advanced as to be finished probably next autumn. From Prince Albert it is intended to cross the Rocky Mountains, by the Yellowhead Pass, and tap the mining regions of British Columbia, ultimately reaching the Pacific Coast.

"Spencer Wood," the residence of the Lieut. Governor of Quebec, and the avenue leading to it, is being lighted by electricity, the outfit comprising several hundred lights. The historic establishment has hitherto been lighted by coal oil and candles.

Electric Flashes.

The town of New Glasgow, N.S., is installing a complete fire alarm system to cost $3,000.

The Edison Electric Light Co., of Kentville, N.S., have put in another dynamo for 200 lights.

Young Bros., Almonte, have installed an electric light plant in the mills of James Paris, White Lake, Ont.

The Canadian Electric Light Co., Levis, P.Q., has made a contract with the corporation of Levis for the lighting of that town. The company will also construct a pulp factory at Chaudiere Falls.

The Cataract Power Co., Hamilton, have found the 25-ton Smart-Eby Co.'s crane, which they installed in their powerhouse at DeCew Falls, to have been an indispensable tool in handling heavy machinery.

The Benjamin Manufacturing Co., of Yarker, Ont., are increasing their lighting plant by a 300-light generator and are also installing a 25-h.p. electric motor. The contract has been awarded to the Jones & Moore Electric Co.

Geo. J. Gibson, W. H. J. Evans, Niagara, Ont.; R. B. Hamilton, John Kyles and Wm. McCabe, Toronto, have been incorporated as the Queenston, Niagara and Port Dalhousie Electric Railway Co., Ltd. Capital, $40,000; head office, Niagara-on-the-Lake.

The Montreal Street Railway Co. has placed an order with the Can. Gen. Elec. Co. for a direct connected railway power generator of 850-k.w. capacity, or about 1,200-h.p. It will be installed at the company's steam station, and will be direct-connected to a cross compound engine.

Wilson, Munroe & Cassidy, bookbinders, have installed electric motors of the Jones & Moore Electric Co.'s manufacture, in their new premises, York street, Toronto, and are also lighting the establishment throughout with enclosed arc lamps purchased from the same company.

Thomas Ahearn, W. Y. Soper, R. W. Shannon, J. D. Fraser and Redmond Quain, Ottawa, Ont., have been granted a charter as Ahearn and Soper, Ltd., to take over the business of Ahearn and Soper, dealers in electrical supplies, etc.; capital, $500,000; head office, Ottawa, Ont.

The Indian Head Vidette learns that correspondence has been going on for some time past between Fort Qu'Appelle business men and Toronto capitalists respecting the building of an electric railway from Fort Qu'Appelle to Indian Head, and that encouraging news has just been received from Toronto by the promoters, Messrs. Boyle, Fetherstonhaugh and Williams, of Fort Qu'Appelle.

A new isolated lighting and power plant is being put into the Asylum for the Insane at Kingston. It consists of two 30-k.w. generators direct connected to two Ideal engines (the Goldie & McCulloch Co.), with 9 x 10 cylinders. It will have a capacity for 1,000 lights, the plant to be used for power for the institution during the day. The electrical machinery, including marble switchboard, is furnished by the Can. Gen. Elec. Co.

The Brandon, Man., Electric Co., are establishing a long distance transmission system, and are erecting a plant at a water power 10 miles distant from the town. The equipment will be furnished by the Can. Gen. Elec. Co., and consists of a 500-h.p. generator, and a 500-h.p. synchronous motor, with 500-h.p. in step-up transformers, and a like power in step-down transformers. The transmission will be carried out on the three-phase system, at 10,000 volts. The local company has a very fine steam plant, which will be retained in case of need.

Since the purchase by Brockville of the local gas and electric light company's plant for $85,000, the light commissioners engaged a New York expert, named Blossom, to make an inspection. His report practically condemns the whole plant, which is not only out of date, but in a very bad condition. The value of what material might be utilized would be about $30,000, but the wiring, etc., is of little account. To repair the systems as they now stand would cost about $63,000. Mr. Blossom favors concentration of the two plants and building a new system at an estimated cost of $125,000.

Work is progressing on the Preston-Berlin electric railway.

The Penetang & Midland Electric Street Railway Light & Power Co., H. R. Carruthers, of Millbrook, and Dr. Thompson, of Cayuga, have installed the Manhattan system of series, A.C., enclosed arc lighting.

The Packard Electric Co., St. Catharines, are continuing to send out their serviceable calendar blotter and memo. books. The calendar for January contains timely advice to users of lamps, as to how to start the new century.

The city of St. Catharines has been trying for some time past to develop electric power from the Welland Canal. It forgot, however, to figure on the fact that the water power of the Niagara Peninsula has been cornered by the Attorney-General of Ontario for the benefit of his company, the Cataract Power Company. The city applied for water power last spring, but it was put off on the ground that the Government engineer would have to report on the capacity of the Welland canal to furnish the supply asked for before the request could be granted. It now turns out that the power which should have gone to St. Catharines was being held in reserve for Attorney-General Gibson's own private company.—Toronto World.

In this age where every minute saved to the head of an establishment and to his employees is of vast importance, and where labor and time saving devices are eagerly sought after by all classes of business, it requires no great effort to persuade business men that to be able to sit at one's desk and communicate instantaneously with any or all of the departments is a convenience that can hardly be estimated in dollars and cents. This fact is being amply proven by the large number of private systems which the Jones & Moore Electric Co. are installing in various places. At present they are placing systems in the establishment of P. Jamieson & Co., the Park-Blackwell Co., Nesbitt & Auld and the Robert Watson Co., Toronto.

Since our last issue was made up for the press, the Canadian General Electric Co. has acquired the large manufacturing plant of the Royal Electric Co., at Montreal, thus absorbing the only considerable opposition it had in the manufacture of electric plants of large units The Royal Electric Co. will now confine itself to its local interests in supplying light and power in the island of Montreal. The manufacture of electrical machinery will be continued at Montreal, on the same lines, under the new regime, but there are some changes in the staff of the respective works. C. A. Barton general superintendent of the Peterboro works, having resigned, has been succeeded by E. G. Patterson, while Hazen Ritchie, chief engineer at Peterboro, goes to the Montreal works, as general superintendent. L. de Witt Magie, till now chief engineer of the Royal Electric Co., at Montreal, takes Mr. Ritchie's place at Peterboro. J. J. Ashworth, of the sales department of the Canadian General Electric Co., is now general sales' agent for the Canada Foundry Co., which now forms part of the C. G. E. Co.'s business. This branch is about to be greatly extended, as mentioned elsewhere, and R. H. Gilmour, late superintendent of the Waterous Engine Works, has been engaged as general superintendent of the new works. H. G. Nicholls, eldest son of Frederic Nicholls, the general manager of the Canadian General Electric Co., has been appointed private secretary to that gentleman, and assistant secretary to the company.

With regard to the closing down of the electric plant at Aurora, Ont., by which the inhabitants were left in darkness last month, the mayor has given the following statement: "Our town's contract with the Royal Electric Light Co. expired on November 18. The Royal Electric Light Co. did not ask to further business, but their engineer here, saying he had backing, offered to build a plant at a cost of about $7,000, on our waterworks premises, and asked for a ten years' contract, for the lighting and pumping of the town, which the council would not accept. We then met the Royal Electric Light Co., and asked them to give us a tender for the street lighting of the town, and also for the domestic purposes as well, on their present location or any other place in the town, with the exception of our water works ground, which their agent agreed to do. But at a following meeting the agent was present, and said his company was willing to carry out the engineer's proposal, but was not willing to make an estimate of another plant, which he agreed to do at the previous meeting, but they were willing to continue the light for three months, and in order to do that they would compel the town to pass a bylaw for the purchase of their plant by the municipality, which the council also rejected. So they finally closed down the plant, and this is the way the matter stands at the present time." Coal oil lamps and candles are now being used in the town, and a number of citizens are installing acetylene gas plants.

Mining Matters.

The Rock Lake Mining Co. have placed their order with the Smart-Eby Machine Co., Hamilton, for two centrifugal sizers, and three smoke-stacks.

The Wabigoon Star notes the finding of an apparently valuable iron deposit, near the C.P.R. track, by Monks & Campbell. It is a banded formation about 500 feet wide, and can be traced for some distance.

W. H. Roughsedge, Henry MacLaren, J. W. McRae, Thos. Dunderdale and Alphonso Macfarlane, Ottawa, Ont., have been incorporated as the Northwest Gold Dredging Co., Ltd.; capital, $1,000,000; head office, Ottawa, Ont.

Albert Upton, Duluth, Minn.; Edgar Brown, John McKay, Sault Ste. Marie, Ont., and James Stobie, township of Johnson, District of Algoma, have been incorporated as the Stobie Mining Co., Ltd.; capital, $1,000,000; head office, Sault Ste. Marie, Ont.

Albert T. Dunn, Musquash, N.B.; Andrew Malcolm, Fred. A. Jones, James V. Russell, St. John, N.B.; Morris Marks, Circle City, Alaska, are applying to the Government of New Brunswick for incorporation as the Golden Nugget Mining Co., Ltd.; capital, $30,000; head office, Fairville, N.B.

The Bruce Copper Mines Co., Ltd., have placed their order with the Smart-Eby Machine Co., Ltd., of Hamilton, for one 150-h.p. Brown engine, one 40-h.p. slide valve engine with Meyer's adjustable cut-off, and one 50-h.p. high-speed electric light engine; one two million gallon tandem compound pumping engine, together with all shafting, pulleys, screens, etc., for their concentrating plant.

J. W. Peters, of the C.P.R., says that 800 tons of ore per day is being handled in the Boundary country. The smelter of the Dominion Copper Company, at Greenwood, will be ready to blow in this month. The Grand Forks smelter is handling 600 tons of ore per day. When, however, the Dominion Copper and the pyritic smelters are put in operation the output will be increased.

There has been considerable activity of late among those interested in the Nova Scotia Coal, Iron and Copper Co., whose property is near Antigonish. The iron areas are about fifteen miles from Antigonish town, and the coal areas about eight miles from the same place. The coal seam is about seven and a half feet in width. A survey has been made for a railway at Arisaig and along the Gulf shore. Among those interested are, Joseph Pushie, ex-Mayor Stephen and Dr. Crowie, New Glasgow, N.S.; N. A. Rhodes, Amherst, and C. B. Whidden, of Antigonish.

The Engineering and Mining Journal in its summary of the mineral and metal production of the United States for 1900 shows that the total gold production of the world in 1900 amounted to $256,462,438, compared with $313,041,534 in 1899, the decrease being entirely owing to the stoppage of gold production in the Transvaal by the war In 1900 the United States took the lead among the gold producing countries, with $78,658,755; Australia ranking second, with $75,283,215. The large production of the Klondike has put Canada in the third place, with a total output of $26,000,000, while Russia was fourth, with $23,000,862.

The Assay office, Belleville, reports that iron ore is being shipped from the following mines in that district, most of the product going to the Hamilton and Midland smelters, making coke pig iron: Wallbridge mine, Hastings Co., hematite Magnetic ore from the following in Hastings county: St Charles mine, near Millbridge; St. Charles mine, near Bancrockburn; Coe Hill mine, Coe Hill; Malone mine, near Malone. Also magnetic ore from deposits along the K. & P. railroad

Calabogie mine near Calabogie; Robertsville mine near Sharbot Lake; Wilbur mine near Wilbur. The following iron properties are being opened up with a view to shipping: Empey mine near Eldorado, hematite ore, operated by Messrs. Farnum and Wellington, of Madoc. Childs & Spragge, properties near Hermon P.O., Hastings county, being high grade magnetite, operated by the same parties. A magnetic property north of Verona, Frontenac county, being tested by diamond drill by J. Kellerschon and others.

A Canadian had the honor of presiding at the annual meeting of the Geological Society of America held last month at Albany, N.Y. The retiring president, Dr. G. M. Dawson, director of the Geological Survey of Canada, gave an address on the Cordilleran Belt in British Columbia. Among the Canadian Geologists present were Prof. F. D. Adams, Prof. O. E. LeRoy, of McGill University; Prof. A. P. Coleman, of Toronto University, Dr. Robt. Bell, Dr. H. M. Ami, Mr. W. McInnis, of the Geological Survey of Canada. The Canadians who read papers were Dr. Robt. Bell, on the Laurentian Mountains of Baffin Land; Prof. Coleman, on the Pleistocene Geology of Canada; Prof. LeRoy, on the Geology of Rigaud Mountains, and Dr. H. M. Ami, on a New Formation in Nova Scotia, a bit of old red sandstone of Europe. Prof. Coleman was elected a member of the Executive Council.

Marine News.

Contracts will shortly be invited by the Dominion Government for a vessel to replace the wrecked steamer "Newfield."

Folger Bros., Kingston, have arranged for the building at Buffalo of another handsome steam yacht, to be placed on the St. Lawrence.

The steamer, "Advance" is having a direct-connected incandescent lighting plant installed. The order has been given to the Jones & Moore Electric Co.

F. A. Knapp, whose roller boat built at Toronto two years ago will be remembered, is trying to interest Montreal grain men in a proposal to build grain barges on the roller principal.

The amalgamation of the Brockville Navigation Company and the Rockport Navigation Company, operating on the St. Lawrence, is talked of. Several of the directors are interested in both companies.

The Jones & Moore Electric Co. have received an order from the Wm. Hamilton Mfg. Co., Peterboro, for a direct connected incandescent lighting plant for a dredge. The order includes engine, dynamo, switch-board, and all wiring materials.

MacLeod Stewart, Ottawa, who is interested in the proposed Georgian Bay Canal, has recently returned from England. No arrangements have been concluded with English capitalists for the project as yet.

The syndicate, of which F. H. Clergue is head, propose to establish a passenger and package freight line on Lake Superior. There will be two tourist routes from Lakes Erie and Huron to the picturesque spots on the north of Lake Superior. Five steel Clyde-built steamers will form the beginning of the fleet.

Personal.

Frank Speller, B.A Sc., will have charge of preparing the mineral exhibit of Ontario at the Pan American Exhibition. The exhibit will be gathered at the Bureau of Mines, Toronto.

A. W. Campbell, C.E., of the Good Roads Department of the Ontario Government, and Andrew Pattullo, M.P.P., of Woodstock, Ont., are hon. vice-presidents of the National Good Roads Association of the United States. The next convention will be held in Buffalo at a date yet to be fixed.

R. H. Gilmour, for seven years superintendent in the Waterous Engine Works Company, Brantford, has gone to the Canadian General Electric Co. Before leaving he was presented by the employees with an address and a set of silver table cutlery, and by the apprentices with a gold headed ebony cane.

George A. Fuller, the first builder to use modern steel skeleton construction, died on the 14th Dec., in New York City.

A. G. Elvin, master mechanic of the G.T.R. shops, Montreal, has resigned, and will be succeeded by someone promoted from the staff in Canada.

Matthew R. Davis, of the firm of Robert Davis & Sons, boat-builders, Kingston, has been appointed Government inspector of hulls, to succeed the late Alex. Horne. Mr. Davis, as a shipbuilder and designer, is eminently fitted for the post.

A. B. Tower, of Tower & Wallace, mill engineers, New York, N.Y., is applying to the Quebec Government for an act authorizing him to became a member of the Canadian Society of Civil Engineers and the Province of Quebec Association of Architects.

Frank Brothers, a Canadian contractor, who built a section of the C.P.R. and superintended the construction of the Montreal street railway, died last month in Cuba, where he was superintending the construction of the new railway now being built through Santa Clara by a company promoted by Sir William Van Horne. He died of typhoid fever while his wife was ill in Toronto.

Wm. Polson, founder of the business of the Polson Iron Works, Toronto, died on the 7th inst., aged 66. He was born in Montreal, and started his career as mechanical superintendent of the Cobourg, Peterboro, & Marmora Railway. He started the Polson Iron Works in 1883. He leaves one son, Frank B. Polson, present manager of the works, and one daughter.

Capt. Arthur E. Hodgins, who went to South Africa as an officer of the Royal Canadian Regiment, has been appointed chief officer of construction in the Imperial Military Railway of South Africa. He will be next in authority to Col. Girouard, the director general, also a Canadian. He is a civil engineer, who worked on construction of the C.P.R. and Crow's Nest Pass railways.

Hazen Ritchie, chief engineer of the Can. Gen. Elec. Co.'s works at Peterboro, has been transferred to Montreal to take charge of the Royal Electric Co.'s works, now forming part of the former company's business. When he left Peterboro' Mr. Ritchie was entertained at a banquet given by the citizens, at which Mayor James Kendry, M.P., presided. Sir John Bourinot, Hon. J. R. Stratton, Hon. R. Symonds, Ven. Archdeacon Casey, and others being present. During the evening the guest was presented with a handsome watch charm and a signet ring. Mr. Ritchie is a son of the late Sir William Ritchie, Chief Justice of the Supreme Court of Nova Scotia.

Dr. Carl Hoepfner, the German metallurgist, so well-known in Canada in connection with his processes of extracting nickel and copper ore, died last month at Denver, Col., from typhoid-pneumonia. He was born in Central Prussia, and was educated at Berlin, where he took the degree of Ph.D. In 1882 he went to Southwest Africa, then newly acquired by Germany, but returned after a short time to become chief chemist of the firm of Siemens & Halske, Berlin, where he partially worked out the ferrous-sulphate process of copper extraction from ore now used by that firm. He also began developing his cuprous chloride process of refining nickel and zinc ores, which eventually brought him to Canada. Coming to the United States he had to face a law-suit with a Cincinnati firm, which had started to use his process; and in 1894 he came to Canada to form, with Hon. J. M. Gibson and John Patterson, of Hamilton, the syndicate, which later became the Hoepfner Refining Co., to work his nickel and zinc processes. In the course of time differences arose between him and the syndicate, which finally discarded his process to take up that of Hans Frasch, who had come over from New York to work under Dr. Hoepfner. A new company was formed under the name of the Nickel-Copper Co., to whom the Hoepfner Refining Co., leased its buildings and plant; and it was the worries of the legal fight to prevent this transfer that led to his fatal illness. He was unmarried, and a sister at Frankfort-on-the-Main is the only near relative he left. Dr. Hoepfner's zinc process is in successful use at the Brunner Mond Alkali Works, Norwich, England.

NEW CATALOGUES.

W. R. Perrin & Co., 500 Forty-Sixth St., Chicago; manufacturers of power, hydraulic, and filter presses. Canadian branch, 122 Church street, Toronto.

A neat illustrated booklet on the new shops of the Canadian Rand Drill Co. Sherbrooke, P.Q.

Metallic Roofing Co., of Canada, Ltd., Toronto, artistic pamphlet describing their interior metallic decorations.

Moore & Alexander, 16 Adelaide street W., Toronto, engravers' and designers' attractive booklet, "20th Century Ideas."

A. A. Griffings' Iron Co., Jersey City, N.J., manufacturers of Bundy steam and oil separators, exhaust heads, boiler coverings, etc.

B. Greening Wire Co., Ltd., Hamilton, a series of three catalogues, one describing their wire ropes and cables, another wire cloth, etc.; and the third perforated metal goods.

Special illustrated catalogue of the Jeffrey Mfg. Co., Columbus, Ohio, manufacturers of chain belting, steel cable conveyors, elevators, carriers and labor-saving appliances for the saw, lumber and wood-working industries.

English Electric Manufacturing Co., Limited, Preston, Eng., for whom Dick, Kerr & Co., Ltd., 110 Cannon street, London, are selling agents; a description of the equipment of their large engineering and electrical works.

Owing to pressure on our space this month we are unable to give detailed notices of the following catalogues, but the firms issuing them will, no doubt, mail copies to any of our readers interested, if the Canadian Engineer is mentioned:

Eastern Machinery Co., New Haven, Conn., describing their improved friction clutches, clutch pulleys, and friction cut-off couplings; also one on their conveying hoisting machinery, including tracking and trolley system, for factory, mining, quarrying, wrecking, dredging and other work.

Good Roads Machinery Co., Hamilton, Ont., catalogue referred to elsewhere.

Consolidated Telpherage Co., 20 Broad street, New York, manufacturers of electrical aerial cableways.

International Correspondence Schools, Scranton, Pa., describing their courses of study in electric power and lighting.

Art Metropole, Toronto, beautifully illustrated "Book of Prices," particularly interesting to draughtsmen, architects, designers, and others who use mathematical and drawing instruments and accessories.

METAL TRADE OF GREAT BRITAIN WITH CANADA.

The following are the sterling values of the exports of metals, etc., from Great Britain to Canada for Nov. and the eleven months ending Nov. of 1899 and 1900:—

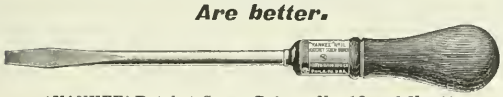
	Month of Nov.		Eleven months ending Nov.	
	1899	1900.	1899.	1900.
Cutlery	£6,346	£3,895	£49,693	£54,383
Hardware	2,356	2,620	19,302	25,998
Pig iron	10,331	3,382	36,323	43,987
Bar, etc.	10,694	1,035	32,028	14,335
Railroad	.....	2,080	152,881	73,169
Hoops, sheets, etc.	17,412	8,350	110,371	75,281
Galvanized sheets	11,604	9,591	69,193	57,703
Tin plates	46,885	64,149	235,470	323,409
Cast, wrought, &c., iron	11,641	1,389	61,891	36,070
Old (for remanufacture)	2,652	....	7,725	9,559
Steel	30,015	4,930	140,355	136,604
Lead	1,790	1,793	43,578	23,719
Tin, unwrought	4,380	3,537	23,943	39,142
Alkali	9,128	4,543	42,324	62,189
Cement	7,763	.....	38,300	56,586

Among the imports of Great Britain from Canada, wood pulp figures to the value of £124,265 in the eleven months of 1899 and £224,587 in 1900, showing a big development of this Canadian industry.

Other Tools are very good Tools, but—

'Yankee' Tools

Are better.

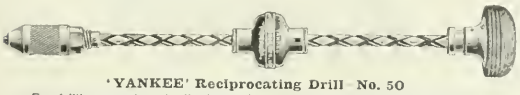


'YANKEE' Ratchet Screw Driver—No. 10 and No. 11
Sizes: 2, 3, 4, 5, 6, 8, 10, 12 inches.

'YANKEE' Ratchet Screw Driver—No. 15
Slim blade, with finger turn, for light work. Sizes: 2, 3, 4, 5 inches.

'YANKEE' Spiral-Ratchet Screw Driver No. 30
Drives or takes out screws by pushing on handle, or by ratchet movement. Can be used as rigid screw driver at any part of its length.

'YANKEE' Automatic Drill No. 41
For boring wood for setting screws, brads, nails, etc., can be used in hard or soft wood without splitting. Pushing on handle revolves drill. Each drill has 8 drills.



'YANKEE' Reciprocating Drill—No. 50
For drilling metals and all kinds of woods. Chucks will hold drills 3-16 diameter or less.

Pocket Magazine Screw Driver No. 60

Sold by leading dealers in Tools and Hardware.

Insist on "Yankee" Tools if you want the best. "Yankee" Tool Book mailed free.

NORTH BROS. MFG. CO.
PHILADELPHIA, PA., U.S.A.

WARREN'S
PULLEY COVER

will save you

POWER——MONEY

By keeping your belts from slipping while allowing them to run slack. IT'S THE NEW CENTURY WAY—SCIENTIFIC, ECONOMICAL, BEST. SENT ON TRIAL. YOU RUN NO RISK.

Gives Your Pulleys Firm Leather-Like Surfaces

It does not make Your Belts Cling or Stick to The Pulleys

Write us for full particulars. Or, upon request, we will send you a case (125 sq. ft.) on thirty days' trial, at $12, less carrying charges, to be paid for only if satisfactory.

THE WARREN CO.,
(Incorporated) Manufacturers
22½ Jackson St., CHICAGO, ILL.

CRANE COMPANY AT THE PARIS EXPOSITION.

One of the exhibits at the Exposition Universelle, Paris, which attracted wide attention was that of Crane Co., the largest manufacturers of valves and fittings in the world, the head offices and factories of which are located in Chicago. This

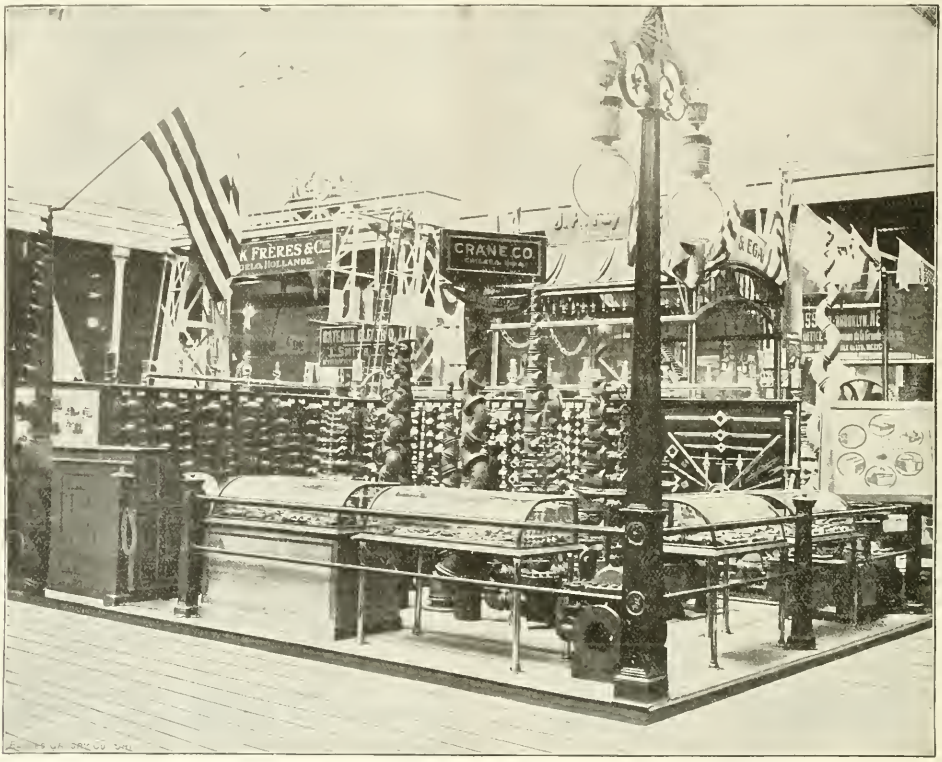


exhibit occupied a desirable position in the Palace of Machinery and Electricity, Champs de Mars, and consisted of brass and iron valves and cocks for all pressures, brass and iron fittings, steam specialties, engineers' supplies, and steam and gas fitters' tools. Crane Co. was the only exhibitor of this class of goods to receive a gold medal. The exhibit was tastefully arranged, as will be seen from the accompanying photograph, and gave an especially good opportunity to visitors to study approved modern methods of piping, flanged work, etc., for power plants —a branch of the business of this company which has become very important.

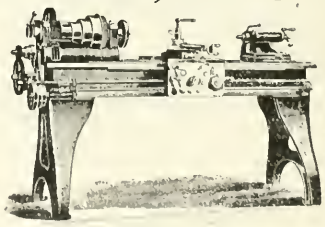
The Canadian Engineer desires to acknowledge with thanks the receipt of calendars from the following firms: John M. Henderson & Co., manufacturers of cableways and hoisting and conveying machinery, etc., Aberdeen, Scotland; Ashton Valve Co., Boston, Mass., U.S.A.; Philip Carey Mnfg. Co., Lockland, Ohio, manufacturers of flexible cement roofing, etc.; News and Advocate, St. Johns, Que.; John Morrow Machine Screw Co., Ingersoll, Ont.; Mining Engineering, Wigan, Eng.; La Patrie, Morton, Phillips & Co., manufacturing stationers, James Robertson Co., Ltd., manufacturers of paints, saws, metals, etc., Montreal, Que.; Northern Assurance Co., Western Assurance Co., Beardmore Belting Co. and Dominion Dyewood & Chemical Co., Toronto; B. Greening Wire Co., Hamilton, Ont.; Standard Tool Co. Cleveland, Ohio; Hamilton Facing Mill Co., Hamilton; Publishers' Collection Agency, New York, N.Y.; American Bicycle Co., Hartford, Conn.

A COMPETENT BOOK-KEEPER wishes situation as accountant, or for general electrical work. Address, **R.H.**, c/o Canadian Engineer.

WANTED A Mechanical Draughtsman. One accustomed to general machine design preferred. Address D. B., care of Canadian Engineer, Montreal, P. Q.

W. G. McNEILL THOMPSON
Consulting Engineer
M. Inst. C.E., M. Can. Soc. C.E., M. Am. Soc. C.E.
59 James Street, - - ST. CATHARINES, Ont.

The London Machine Tool Co.
London, Ontario



Lathes
Planers
Drills
Shapers

Hammers
Bull
Dozers
Punches
Presses

MANUFACTURERS OF
General Machinery

RAILS NEW AND SECOND HAND

JOHN J. GARTSHORE
83 Front St. West, Toronto
(Opposite Queen's Hotel.)

For Railways, Tramways, Girders, etc. All sections. Contractors' plant. Old material, etc., bought and sold

The Canadian Engineer

VOL. VIII.—No. 10. TORONTO AND MONTREAL, FEBRUARY, 1901. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,

E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE		PAGE
Bernier, Capt., Trip to the North Pole	206	Kennedy, Walter	205
Bricks from Sand	213	Literary Notes	212
Canadian Bridge Co.	212	Lunkenheimer Injector	202
Can. Soc. of Civil Engineers	207	Marine News	214
Catalogues, New	213	Masonry Dams and Retaining Walls in General, Concrete Works, etc.	219
Chimney, Highest in the World	203	Motors, Heat	xxxiv
Chlorination Plant, Brookfield	203	Metal Imports from Great Britain	xxxiv
Clergue, F. H., Enterprises of	210	Mining Matters	218
Copperine, Spooner's	iv.	Personal	219
Cramp-Ontario Steel Works	204	Pike Mfg. Co.'s Exhibit	206
Education, Scientific	199	Pulley Covers, Warren's	iii.
Electric Flashes	216	Queen Victoria	200
Engineers' Club	212	Railway Matters	217
Engineering Profession, Success in	223	Sturtevant Vertical Engine	202
Fire Prevention Committee	200	Sturtevant Heating and Ventilating System	206
Industrial Notes	214	Tools, Extracting Broken	iii.
Imperial Trade Notes	iv	Weller, J. L.	207
Keating, E. H.	210		

SCIENCE IN EDUCATION.

In this period of our educational development, when the school systems of our provinces are receiving such criticism, the address of Dean Bovey, of the Applied Science department of McGill University, before the Canadian Society of Civil Engineers, on the occasion of his retirement from the presidential chair of the society, will be of interest to the many Canadians who realize that our education needs to be more practical. Prof. Bovey, in his address, observed that as engineers, the society had a special part to play in the betterment of the world, since to men of their profession were due those triumphs over time and space which alone have made the Empire possible. Engineering is indeed a science as well as a profession, as its followers investigate problems directly connected with their work, which the other sciences do not consider, and it may be defined as "a particular combination of sciences joined together with a view to a direct practical result." There is, indeed, a danger that too early specialization may injure true education, and it would be well if the studies followed at school led equally well to either the scientific or the literary branches of the university. A broader training in early years is not a waste of time, and makes the choice of profession, when the moment comes, both permanent and well considered. The true function of science is to ascertain the causes of things and their relation to one another, and as such is a very valuable element in true education, for it gives an insight into our material environment and uncloses the sealed book of nature, while the methods of thought peculiar to it train our mental and moral faculties to meet the needs of life. For the scientific method proceeds by observation, analysis, classification, generalization, deduction and experiment, and these must be used by us in a more or less trained fashion every day. Love of truth, humility and reverence, strenuous effort are all inculcated by the scientific method, and the first telegram sent across the continent—"What God hath wrought"—mirrors a truth that every scientist must feel. But scientific methods are not confined to the mere facts of nature. They may be and are now applied to the problems presented by history, language, literature and philosophy, although their power is unable to produce the beauties of poetry or the triumphs of faith. Still in the teaching of science the application of its own methods produces results which can be obtained in no other way. For it is the best known method of study, and as such should be studied in itself; it trains the eye, the ear and the hand; it encourages concentration of mind and the close grasp of facts; it emphasizes the relations of cause and effect; it involves the study and accumulation of facts, and offers a free scope for the exercise of the human powers, and lastly, it fits a man more directly for his career in life than any other course. Surely, then, science should be taught to everyone. But there are difficulties in the way of scientific education, and the conflict between those who desire that the student should learn nothing that is not of direct practical use and those who discourage excessive and premature specialization in education is still fiercely waged. Some compromise is necessary and perhaps the most practicable is the option system. A somewhat freer choice of subjects than at present might be allowed, but the true purpose of education, the training of the mental powers, must be preferred to the teaching of mere knowledge, however directly useful. Perhaps the study of engineering, combining as it does a training in sciences and in their practical application, is the best fitted to fulfil both these purposes. Science, besides its great function in the training of the mind, has accomplished marvellous victories for the good, moral and intellectual, as well as mental, of mankind. If we look forward to a new century as remarkable for its inventions as the last, let us remember that these inventions must be won with the same weapons as those of our forefathers, and strive to emulate the patience and determination of Darwin, the resourcefulness of Stephenson and the reverent humility of Faraday.

Equally interesting are the views of Prof. John Galbraith, principal of the School of Practical Science, Toronto, on scientific education as given in a recent address on the work of that institution. Prof. Galbraith inclines to the view that although it may be true one cannot make a success in life unless he specializes, it by no means follows that this specializing must be done in the School. He thinks on the contrary that the best basis for successful specializing is a sound general training. "One of the great advantages of a course of study in a school

of science," he says, "is that the mind of the student is almost unconsciously trained in the classification of facts. He cannot attend the various classes for three or four years without knowing to what departments or sub-departments of science the facts of observation are to be referred, and even if he has forgotten how to apply the sciences he knows at least where and how to get the information he requires without loss of time. His course in the School has supplied him with a great catalogue of knowledge. This is true, in a measure, even in the case of students who fail to complete their course. Another function of the engineering school, besides the training of students for the professions, is the training of men for research work connected with engineering. There seems to be more difference of opinion with regard to the proper training of the mechanical and electrical engineer than in the case of the civil engineer and the architect. To spend time working as a tradesman is not the custom in the latter professions, while in the former we find men with all degrees of workmen's experience, from zero to the maximum amount. Roughly speaking, mechanical engineering, like all Gaul, is divided into three parts, of which one is occupied by the designing and consulting engineer, who in his functions most resembles the civil engineer and the architect, and who generally enters the profession by the drafting room door. Another part is occupied by the works manager in manufacturing establishments, who corresponds, in a measure, to the contractor for the civil engineer and the architect, and who enters by the shop door. To the third part belongs the engineer in charge of the engines and boilers, pumps and dynamos. He enters by the engine room door. Manual experience, as it may be called, is an absolute necessity in the case of the latter two classes, while it is not in the case of the first. On the other hand, the practical knowledge which can be gained only by familiarity with manufacturing operations, and with the operation of power plants, is an absolute necessity for the three classes."

This practical knowledge, Prof. Galbraith thinks, cannot be obtained in the engineering school, and he doubts that any great advantage is gained by having workshops in the engineering schools to teach students the use of tools. His reasons are that too much time is taken from teaching, while the time thus devoted to shop work is not long enough to make a finished workman. He therefore advised the Ontario Government, in 1888, against establishing a school of shop instruction. The practical training of the mechanic, the foreman and the engineer in charge of small power plants must, it seemed to him, continue to be obtained in the ordinary shops. For scientific instruction they must depend largely on the evening technical schools, and on the correspondence schools. Young men who have the ambition to become managers of works and large power plants ought to make up their minds to attend the higher technical schools, and also to go through the hard manual work necessary to enable them to become fairly competent mechanics. They will be fortunate if they have been brought up in the shops from boyhood, and have at the same time acquired habits of study.

THE BELOVED QUEEN

The Queen is dead, and the Victorian Age has closed with her life. The mere statement of the phrase, the "Victorian Age," is all that is needed to place in monumental form our conception of the Queen's influence upon the life of the world. It is too little to say that her millions of subjects lament her death. The nations of the whole earth stand as mourners at her grave. In doing so they pay their tribute of honor to a sovereign who strove at all times for peace among the powers, and to whom all war was abhorrent. The secret of her great power among her own people and her own family as well as among the rulers of the great nations was her enlightened Christian love, and her high sense of duty, both of which were tried and proved in countless ways in her long life. As for her reign, it stands unique, not only in the long history of Great Britain, but in many respects in the history of all nations from Chaldea and Egypt to the Kingdoms of the present day. The great monarchs of ancient times who extended their rule over the earth by victorious armies, left the subject peoples whom they conquered pretty much as they found them so far as "liberty and the pursuit of happiness" was concerned; whereas a large part of the marvelous extension of the British Empire in Victoria's day has been brought about by appeals in favor of her rule by the subject peoples themselves, and wherever British sway has extended the natives have been benefited, and their burdens lightened. Under her rule the chains from the slave "dropped off like lead into the sea," and it is only since her reign that other nations have come, by Britain's example, to regard slave holding as a crime. Her good name is not only stamped upon the age itself, but upon every phase of the complex life of the nineteenth century. Countries, provinces, counties, cities and towns have taken their name from her; rivers, lakes, bays, mountains, islands and every other feature of the earth's face bear her name, and hundreds of every sort of institution in social, religious, moral and political life have been baptized in her name. And marvelous is this testimony to the exalted purity of her nature, that in not one case has her name been used by an institution calculated for the demoralization of the people. We can only say with Tennyson, "She wrought her people lasting good."

"Her court was pure; her life serene;
God gave her peace; her land reposed;
A thousand claims to reverence closed
In her as mother, wife and Queen.

"And statesmen at her council met
Who knew the seasons when to take
Occasion by the hand, and make
The bounds of freedom wider yet.

"By shaping some august decree,
Which kept her throne unshaken still
Broad-based upon her people's will
And compass'd by the inviolate sea."

Resplendent as her life has been with multiform examples of Christian duty, and loyalty to the higher interests of her people, we believe her name and influence will be more exalted throughout the world now that she is gone than it ever was during her life.

BRITISH FIRE PREVENTION COMMITTEE

With the close of the year 1900, Edwin O. Sachs, as Chairman of the British Fire Prevention Committee, makes the following announcement regarding the Fire Tests carried out under the auspices of that body, which will give some idea of the amount of work done in the form of investigations, quite irrespective of the general duties of the Committee:

Since the Committee's incorporation there have been twelve tests with fire-resisting floors and two with ceilings and nine tests with fire-resisting partitions. There have been no less than twenty-three tests with different forms of wood and iron doors, and eight with various forms of glazing. Besides this, there have been several odd tests with treated wood, fire curtains, fire blinds, girder coverings and safes. Altogether, the tests number sixty-three. The reports on these sixty-three tests are embodied in forty-four publications, many of which are extensively illustrated. An analysis of the attendance at tests shows that, including the representatives of the Council

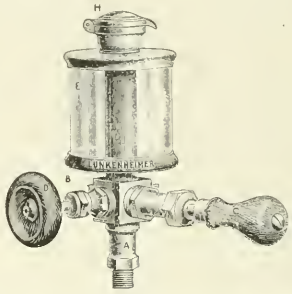
OUR QUEEN OF HALLOWED MEMORY

Executive, the various sub-committees and the deputies of the general body of members, the attendance averaged about forty. The working members of the Council were primarily, Sir John Taylor, K.C.B., (H.M. Office of Works), Arthur Cates (lately Crown Surveyor) and Major General Festing, F.R.S., (South Kensington Museum). Unfortunately, towards the close of the year, the Committee was obliged to give up its Testing Station at 35, North Bank, as the property was taken over by the Great Central Railway. It has, however, secured a new Testing Station which is very conveniently situated near Royal Oak Station on the Metropolitan Railway. The Testing Station again comprises a large old-fashioned house, with considerable grounds, and the house is being immediately arranged for the purposes of committee rooms, a museum, and a laboratory, as well as apartments for the resident engineer. It is anticipated that the testing operations will re-commence in the early spring, and applications for tests can now again be received at the Secretary's offices, No. 1, Waterloo Place, Pall Mall, London, W. The Committee has also arranged to participate in the Building Trades' Exhibition which is to take place in April next, and a special hall is to be devoted to the fire-proofing exhibits under its auspices. The Committee's own exhibits will consist chiefly of reports photographs, model of the testing station and the like.

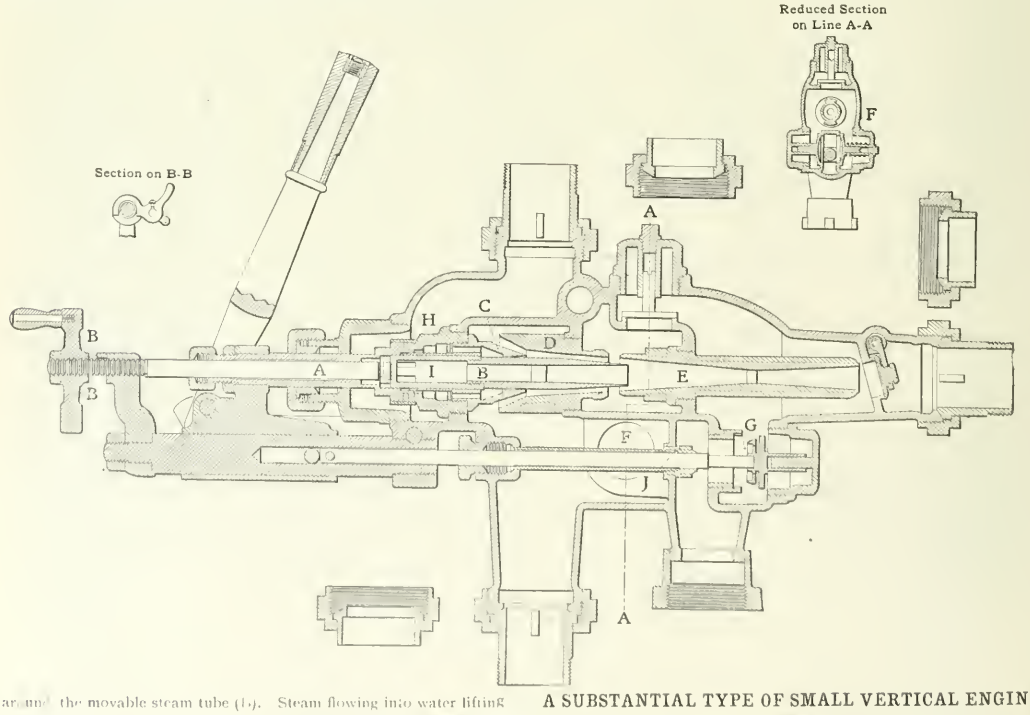
NEW LUNKENHEIMER STANDARD INJECTOR.

Herewith is shown a sectional view of the new injector which the Lunkenheimer Company, of Cincinnati, Ohio, have just placed upon the market. The construction of the machine is novel in a number of particulars, and differs essentially from any of those now on the market.

Referring to the cut it will be noted that by pulling the lever slightly the steam valve (H) is withdrawn from its seat and steam is admitted to the lifting steam jet (C), through the annular space around the movable steam tube (B). Steam flowing into water lifting tube (B) forms a vacuum in the water supply pipe and the water is "lifted" and passes out through check valve (A), also delivery tube (E) past the overflow valve (G) to the atmosphere. Drawing the handle further back opens the ports (I) in movable steam tube (B), thus admitting steam to the interior of said tube, which forces the water through combining tube (F) past line check to boiler, due to the closing of overflow valve (G). Controlled by withdrawal of rod (J). The principal feature in this machine is that the regulation of the water is accomplished by the movement of the movable steam tube (B), the amount of which is controlled by the crank handle at the end of the machine. On this account it differs from all other forms of injectors inasmuch as, in cutting down the discharge of water the steam consumption is reduced in direct proportion. In all other forms of injectors the steam supply remains constant, while the water supply alone is reduced. The manufacturers claim for the injector that it will start promptly under most conditions, and can be depended upon to work reliably at all steam pressures from twenty-five to three hundred pounds, and higher. They further claim that it is distinctively a high pressure injector designed particularly for that service. It is also self-adjusting—that is to say,



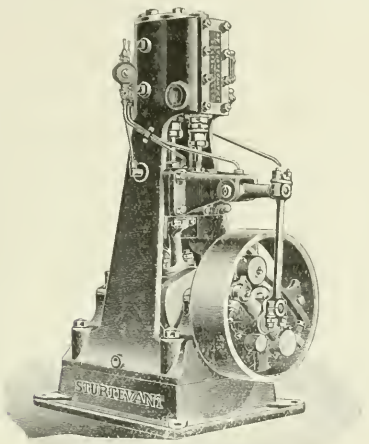
it is not affected by variations of steam pressure, even within great limits, and when started for instance, at seventy pounds, it can be relied upon to work uninterruptedly to three hundred pounds, and a sudden reduction in steam pressure would not disturb its action. There are a number of mechanical advantages about the injector, such as easiness of making repairs and other details, and the manufacturers will be pleased to send a complete descriptive circular upon application.



A SUBSTANTIAL TYPE OF SMALL VERTICAL ENGINE

The accompanying illustration presents a type of a small vertical engine adapted to general use which has recently been brought out by the B. F. Sturtevant Co., of Boston, Mass. It is built in three sizes ranging from 2 to 4 h.p. with speeds from 1000 rev. for the smallest size, and 650 rev. for the largest. It is in aspect a perfect miniature engine, complete in every detail and designed with the utmost care. The frame is rigid in its design, spreads well at the base and resists vibration, notwithstanding the fact that the weights have been kept down to the minimum, ranging from 100 lbs. for the smallest, up to 450 for the largest engine. The steam is distributed by means of a piston valve, actuated by the automatic governor which, as will be

noted, is complete in all its features. The effect of the reciprocating parts is overcome by suitable counterbalance of the crank plates. The connecting rod is of the marine type. All moving parts are adjustable for wear, and a complete oiling system is provided for the individual bearings. The cylinder is lagged to reduce the condensation, and access to the piston valve and steam chest is provided by means of a removable cover. This line of engines was primarily designed by the



Sturtevant Co. for use, with their generators, in torpedo boat service where the minimum weight was absolutely essential. The same type of engine is built to be operated by throttling governor, and is also very generally employed for fan driving, being then directly connected to the fan shaft. The cylinder is tapped for indicator, and is also provided with the necessary drip valve connections. The small diameter of the cylinder and the extra thickness of the walls makes it possible to run these at a pressure of 150 lbs., and even higher, although the powers above specified are those developed at 80 lb initial pressure.

CHLORINATION PLANT OF BROOKFIELD MINING CO.

BY J. NORMAN RITCHIE, JR.

This plant for the treatment of gold-bearing concentrates is situated at North Brookfield, Queen's county Nova Scotia.

Before describing the plant it will be well perhaps to say a few words regarding the ore. The main ore bodies are. One vein parallel to the bedding, and the fissure vein, cutting the strata at a depth of about 70°. This fissure vein is the only one worked at present. It averages about fourteen inches in width of crushing material. The anticlinal ridge, which has an important relationship to the ore deposits is about an eighth of a mile to the south. The quartz vein contains free gold and gold-bearing arsenopyrite and chaleopyrite. Chaleopyrite is considered an indication of gold-bearing quartz in this district, and free gold is frequently seen surrounded by crystals of this mineral. The country west consists of either slate or quartzite.

The tailings from a twenty stamp mill are concentrated on eight Improved Triumph Concentrators. From the mill the concentrates are hoisted up to the upper floor of the roasting building. The concentrates contain about 28% sulphur and 16% arsenic. The object of roasting is to expel as much of these substances as possible by oxidization, as they would be acted on by the chlorine in the further treatment. If any sulphides are present they are oxidized by the chlorine in the presence of water, sulphates and hydrochloric acid being formed. Thus there may be a great waste of chlorine due to imperfect roasting. One per cent of unoxidized sulphur present in pyrite converts 8.9% of chlorine into hydrochloric acid.

The roasting takes place in three hand-reverberatory furnaces, each sixty feet in length and eight feet in width, with a long sloping hearth. Cord-wood is used for fuel. The ore is charged through a hopper at one end of the furnace. The layer of ore is made about two inches deep. The capacity of one of these furnaces is about two tons per twenty-four hours. The ore remains in the furnace in three different spaces, being moved at certain times towards the bridge. In the first space known as the drying space, the ore remains from four to five hours. In each of the other two spaces the ore stays for twelve hours. The ore burns from one to three hours, and after flames leave, sparks are seen, and soon the ore becomes rather liquid and flows somewhat about the furnace. In the last space the ore becomes "hardened up" and of one color throughout. During the roasting the ore is rabbled with long hoes, each furnace being attended to by two men.

When the roasting is completed the ore is worked into a heap at the end of the furnace and drawn out into iron wheel-barrows. It is then dumped on the cooling floor. From the cooling floor it is shovelled on to an elevator which carries it to the top of the chlorination building.

The process of chlorination at these works is known as the barrel process. There are four lead-lined chlorinating barrels, four feet in diameter, and five feet in length. These are revolved by a small electric motor from four to five hours, and at fifteen revolutions per minute. The substances are placed in the barrels in the following order and proportions:

1. Water, 50% of amount of ore,
2. H_2SO_4 20 to 50 lbs. per ton of ore.
3. Ore.
4. Bleaching powder 10 to 20 lbs.

The following reaction takes place

$$Ca\,Cl_6 + Ca\,(OCl)_2 + 2\,H_2\,SO_4 = 2\,Ca\,SO_4 + 2\,H_4\,O + 2\,Cl_2.$$

By the action of the chlorine liberated the gold is converted into the trichloride ($Au\,Cl_3$). One oz. of gold requires 0.54 oz of chlorine to convert it into the trichloride. Commercial bleaching powder, however, does not generate as much chlorine as is represented by the above equation. It often represents only 30% of the amount. This is due largely to the fact that bleaching-powder is decomposed by the carbon dioxide in the atmosphere. After the chlorination is completed the covers are removed from the barrels, and the excess of chlorine allowed to escape outside the building.

The contents of the barrels are then run into 16 lead-lined filters, 6 x 8 feet and 20 inches deep. On the bottoms of the filters are perforated tiles on which rest racks made of slats. These racks hold different sizes of gravel as follow —

1 inch of ¾ inch gravel
1 " " ½ " "
1 " " ¼ " "
1 " " ⅛ " "
¼ " " 1-20 " "

The whole is covered with sacking which lasts eight times. After filtering, the filters are washed three or four times with clean water, and the water tested for gold.

From the filters the solution passes into four lead-lined storage tanks 4 x 8 ft. and 5 ft. in depth. The stuff remaining on the filters is shovelled into cars and sent to the dump.

On the same floor as the storage tanks the ferrous sulphate is made by treating scrap iron with dilute sulphuric acid. A filter is necessary in the tank to keep the carbon from running out with the ferrous sulphate. This filter consists of perforated tiles and three grades of sand.

From the storage tanks the solution passes to the next floor into 16 precipitating tanks eight feet in diameter and three and a half feet in depth. These are made of Florida cypress, painted with an acid proof paint. The gold is precipitated by ferrous sulphate. Eight or 10 buckets of ferrous sulphate solution are added to each tank and the liquid thoroughly stirred. The gold is precipitated as a brown powder. The reaction is:—

$$2\,AuCl_3 + 6\,Fe\,SO_4 = 2\,Au + Fe_2\,Cl_6 + 2\,Fe\,(SO_4)_3$$

After standing two or three days in the precipitating tanks all the liquid except about an inch is drawn off. The residue is treated with from 20 to 40 lbs. of sulphuric acid. This dissolves what ferric arseniate may have been precipitated. The tanks are then tipped by means of jack screws, and the contents carried in pails to settling tanks. After all the gold has settled to the bottom, the contents of the tanks are filtered through filter paper, and the gold dried in pans. The powdered gold is then mixed with sodium bicarbonate and borax glass and smelted.

*A paper read before the Applied Science Society of McGill University.

THE HIGHEST CHIMNEY IN THE WORLD.

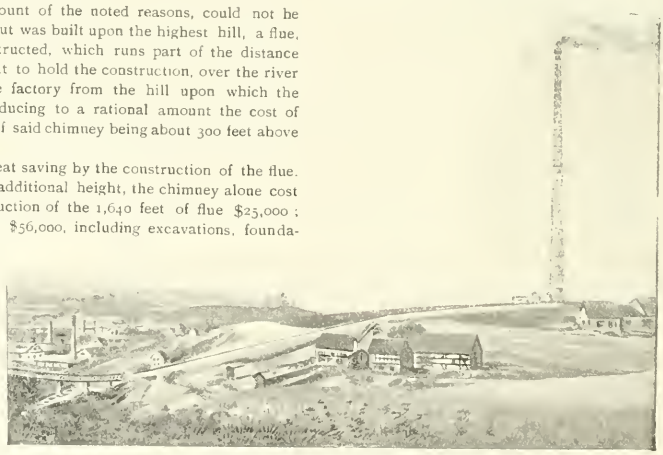
Experience has shown that the proper height of factory chimneys is not alone dependent on the quantity of smoke and poisonous gases to be carried off by them. It is essential that a chimney, especially when its main function is to remove poisonous or otherwise deleterious products of combustion should be constructed to such a height that the escaping gases may cause no harm. This, of course, is particularly true at chemical factories and gas works, where often the poisonous and dangerous products of combustion escape before they clear the

flue, thus demanding costly constructions which are often found extremely difficult to carry out.

The experience of to-day goes to show that an outlet height of about 300 feet above the level is considered sufficient to prevent harmful action to plant life, as well as any interference with the health of people living in the vicinity of the chimney. Should this territory be surrounded with wooded heights it is well to increase in the same ratio the height of the chimney. In rolling or hilly country the outlet of the chimney should be placed at least 300 feet above the highest point of the surrounding hills. A chimney in the valley would, in consequence of this great height, cost so much that it would be cheaper to build the flue of the chimney on the highest point, and erect the chimney proper on the existing higher plane afforded by nature. On account of this aforesaid condition, the Royal Saxon Smelting Works, at Halsbrucke, in Freiberg, were compelled to build a high chimney, which can safely be considered the highest and most prominent chimney of this century. This chimney has a height above the surrounding plane of 459 feet. The height of the chimney itself is 429 feet 6 inches, the square base being 29 feet 6 inches, and, therefore, at the time of its completion, in 1889, it was the highest chimney in the world. The internal top diameter is over 8 feet. As this enormous height did not afford sufficient security for the surrounding neighborhood against the outgoing gases, this chimney was erected upon one of the adjoining highest hills, which is 197 feet higher than the smelting works situated in the valley. In consequence of this position the chimney obtains an additional height, and an increased efficiency equivalent to an altitude of over 656 feet.

As this chimney, on account of the noted reasons, could not be placed next to the factory, but was built upon the highest hill, a flue, of over 1,640 feet, was constructed, which runs part of the distance over a bridge, specially built to hold the construction, over the river Mulde, which separates the factory from the hill upon which the chimney is built, thereby reducing to a rational amount the cost of the construction, the outlet of said chimney being about 300 feet above the adjoining plane.

Notwithstanding the great saving by the construction of the flue, and utilizing nature for the additional height, the chimney alone cost over $31,000, and the construction of the 1,640 feet of flue $25,000; hence the total cost is about $56,000, including excavations, foundations and the necessary iron rings; the two latter costing about $2,620. Even this tremendous cost has been a good investment so far, for the company has not been compelled to pay any damages to the surrounding property holders since the erection of the big chimney, whereas theretofore divers claims had to be satisfied to the extent of 40 per cent, according to governmental decisions.



The Highest Chimney in the World.

The chimney was erected according to the designs of Master Mechanic O. Huppner, of Freiburg, Saxony, by the largest and most prominent firm of German chimney builders. It was begun on the 25th day of September, 1888, and was completed on the 28th day of October, 1889. The system employed was the perforated radial brick plan, similar to the method followed in the erection of the two chimneys at the works of Adam Weber Sons, at Weber, New Jersey, on the Raritan river, which system this firm is introducing into America, it having taken up the work of both manufacturing the blocks, and designing and erecting the chimneys built of such blocks. The blocks used are made of a very highly refractory and smooth clay, entirely free from small stones and pebbles, and which, when burned at a temperature of about 2,000° F. become almost impervious to water. They are also of large face, thus presenting fewer joints to the weather and to the action of the gases. Judging by results and the increasing demands in this line, it will not be long before America will surpass this big construction with a still "taller" chimney.

The following data will be of interest, showing the magnitude of the Freiberg construction. Its base lies 10 feet under the level, and is 30 feet 3 inches square, covering an area of 1,850 square feet. The following quantity of material was used, viz.: 14,885 cubic feet for foundation work; 4,736 cubic feet for pedestal; 63,666 cubic feet for the column, giving a total of 85,285 cubic feet of mason work.

The mason work had a special weight of 124.8 pounds per cubic foot—the entire lot to be carried was 5,308¾ gross tons; and the weight to be sustained by the foundations is increased to 4¾ tons per square foot.

There is no doubt that this chimney, with all its details and peculiarities, is one of the greatest works ever erected in this particular line, and is accepted to day, by the official organs of Germany, as a standard of chimney construction.

CRAMP ONTARIO STEEL WORKS AT COLLINGWOOD.

A large audience of the financial and manufacturing men of Toronto met in the Rotunda of the Toronto Board of Trade on January 17th, 1901, to listen to an address by Walter Kennedy, Consulting Engineer of the Cramp Ontario Steel Company of Collingwood, Ont., which he had been invited to deliver by the Canadian Manufacturers' Association. Mr. Kennedy, who is Consulting Engineer for several of the largest iron and steel companies in the United States, made a very good impression, speaking in an easy conversational way, and inviting the audience to ask him questions so as to keep them interested. P. W. Ellis occupied the chair, and introduced the speaker of the evening in a very flattering manner.

Mr. Kennedy, after paying a compliment to Canada and Canadian progress, and expressing his wishes and belief that Canada and the United States, whose interests were very much bound up together, would always be as good friends as they were now, gave some of his experiences while acting as Metallurgical Engineer for the Chinese Government which were amusing, but certainly not flattering to the honesty of the Chinese, who, he stated, were fatalists, believing that what had been arranged by the Supreme Being and their Ancestors should not be disturbed, which was a very fatal theory for those who wanted to develop the ores of China. Passing on to the main question of the evening, "The Development of the Iron and Steel Industries of Canada," he said that a great development of the iron business in the United States during the last few years had been due in a great measure to the fine collection of raw materials. They had the best advantages in Pittsburg of good coal and coke, clear ore and excellent railway facilities which had enabled them to collect the raw materials very cheaply. Mr. Kennedy stated it as his belief that a canal would be dug in the near future between Pittsburg and the lakes.

Mr. Kennedy said: "The iron business in the last few years has brought a greater amount of wealth in the neighborhood of Pittsburg than any other, and possibly all other industries combined. The iron and steel industry has improved the wealth of the nation and the condition of the people more than any factor in the national and industrial life, and he thought there was a movement now starting in the Dominion of Canada that would be phenomenal in its development of wealth. Dealing with the growth of blast furnaces in the United States he said he could not go further back than the old charcoal furnaces that were operated at one time, and had an average output of four or five tons a day. Twenty years ago 50 and 60 tons a day was considered a large output. He remembered when Lowthian Bell came from England to the United States to see the blast furnace near Youngstown, Ohio, which had an output of 60 tons

a day. Ten years after that 200 tons was considered a good day's work. Now there were at least ten blast furnaces in the United States having a product of more than 600 tons a day; in fact, one had averaged 700 tons a day for a month. There were people who claimed that within the next few years there would be furnaces making 3,000 tons a day, though this seemed an extravagant estimate."

Mr. Kennedy, being asked what was to be done at Collingwood, said:—"Our idea is to equip a plant there suitable for the present needs of the local markets, and if possible, something additional will be exported to foreign countries. It will be equipped with machinery that is the latest and best of its kind for every department. The intention is to form an organization that will be capable of solving the different problems as they arise just as Mr. Clergue and his associates have done at the Soo, and then encourage and branch out into any kind of business that seems most profitable and will build up other businesses in the Province of Ontario. [Applause. The most paying business we have in Pittsburg is the home trade. We ship a good deal of iron and steel abroad, but it has never been anything like the home market. Our plans for Collingwood contemplate the erection of four blast furnaces, one of which will be built immediately; ten open-hearth furnaces, four of which will be built immediately; and a blooming mill, which breaks down large ingots and produces the billet that may be put into any kind of finished article. [Applause.] There has been some talk of starting a wire rod mill, as the wire fence business is becoming a very large one in the western part of this country. There are many lines that could be developed to advantage, but we do not propose trying to do everything at the start." Being asked as to the prospects of competing with the United States in the manufacture of steel for export, said:—"This involves the question of coal." He thought it would be highly important to put soft coal on the free list, so that it could be brought to the works and there converted into coke, saving a very large amount of fuel that was wasted at the coke ovens. In the United States they were not up to the Germans in the economic use of coal. Every good German firm had its plant for the saving of by-products, and if proper precautions were used he thought it was possible in Canada to compete with the United States. [Applause.] The Carnegie Steel Company had lately purchased several thousand acres on the southern shore of Lake Erie, where they contemplated building steel works at a cost of several million dollars, so as to have their new works on the shores of the great lakes. If they could operate successfully at that point there was certainly no disadvantage in coming a little further across the lake. There were many arguments now for assembling the raw material closer to the ore than the coal, because it required only about one-half as much coke now to make a ton of iron as it did years ago, and the proportion now is about two tons of iron ore to one of coke."

On the cost of production he said:—"The consumption of fuel in the manufacture of iron has been cut down at least 15 or 20 per cent in the last 5 or 6 years. The probability is that the reduction will continue, and if it does there will be another great argument on the point of cost. Duluth, I think, will become a great iron manufacturing centre. It may be some time, but that is the prospect. All the locations on the lake shore in the Dominion of Canada will have a future very much of advancement equal to Duluth and equal to the United States. There are some kinds of manufactures, like the manufacture of fine wire and dental instruments, things of that kind, that can never be manufactured in any part of the world as cheaply as in Pittsburg, unless it is in China. The Chinese have facilities that should make them master of the situation when it comes to the struggle for cheapness and the survival of the fittest. That may yet be a long time, unless God in His providence should ordain otherwise."

Mr. Kennedy, in answer to a rattling good speech made by the chairman, asking some pertinent questions, said:—"The iron and steel workmen employed in Pittsburg are supposed to be pretty well paid for their work. They are paid highly in comparison with other workers. Let me give you an illustration of this. You will all remember the Homestead strike. It will be fresh in your minds, as it occurred only about four and a half years ago. Any man in the party for whom that strike occurred got no less than $2,500 a year. The average salary was, I believe, not much less than $4,000 in the particular crowd for whom the strike occurred."

Answering a question as to the probable effect on the increase of population in Collingwood, whose citizens had given the company a free site, and a bonus of $115,000 in cash, he stated that—"The number of men employed at Collingwood would probably not be less than 1,200, from that to 2,000 to commence with. But a great deal would have to depend on the grade of the finished material. It takes many more men to finish a ton of material in thin sheets than in heavy material, such as bridge steel. A great deal also depends on how prosperous is the enterprise, how energetically it is pushed."

I think the conditions are right if the proper kind of judgment and skill are used in the building and operating of the plant, and a part of the money kept always for improvements. That is the practice now-a-days. Our best machine shops take out their old machinery every few years. If some fellow comes along with a machine that will do 10, 15 or 20 per cent. more work in a day than the old one, they will throw the old one out, if it is just as good as new; and that is the principle on which we expect to go.

A gentleman in the audience asked a question as to the different conditions for reducing hematite and magnetic ores. What he wanted to know was the amount of coal and limestone required.

Mr. Kennedy replied that as a rule the magnetic ore required more coal to reduce it. The ore found in the Kingston and Pembroke district was irregular as to the quantity of phosphorus, and was therefore objectionable. He looked more confidently to the Northwest, to that portion of Canada which lay opposite the ore fields which had developed so extensively in the United States. No doubt there was plenty of ore in the Michipicoton district. If the ore taken out was 60 per cent. iron, it would require about 1,700 lbs. of coal to the ton, if the German process were used by which the gas is extracted and the waste products are utilized. He had never used the limestone at Collingwood, but it looked all right. About one-third of a ton of limestone would be required to each ton of ore.

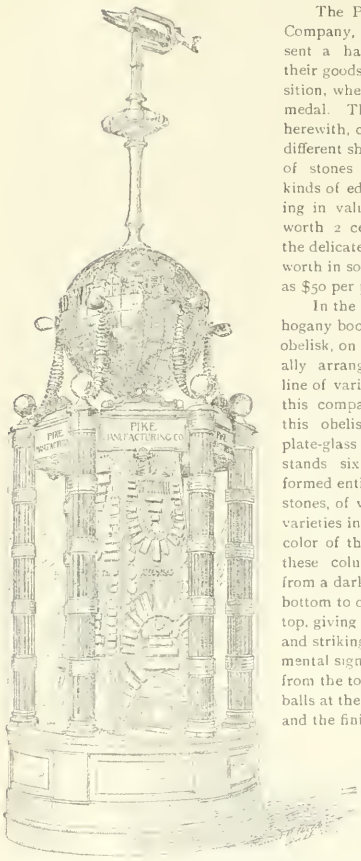
The chairman made some telling points in a speech, short and to the point, and T. W. Gibson, director of the Bureau of Mines, moved a vote of thanks, seconded by J. O. Thorn, of the Manufacturers' Association, to the speaker of the evening, which was heartily endorsed by the audience.

"Since the above was written Mr. T. Sliver, the Mayor of Collingwood, has been visiting the Parliament Buildings in Toronto in connection with some additional water lots, which the town proposes to give to the Cramp Ontario Steel Co., and is reported as stating that in the steel shipyard at Collingwood there was now building for the Beatty Line what will be one of the finest steamers on the route between Sarnia and Duluth. She will be 325 feet long, 43 feet beam, with a molded depth of 27 feet, and built of steel; her engines will be of the triple compound type, with 4 boilers which are to develop 2,500 h.p. and to give a speed of 15 knots an hour loaded, and 17 to 18 when running light."

Walter Kennedy was born in Mahoning County, O., and early became accustomed to the sight of blast furnaces and their operations. He was educated in Poland, O., at the same school President William McKinley attended when a boy. His father, Thomas Walker Kennedy, was one of the most progressive engineers of his time, and was the managing director of the Struthers Iron Company. He was the first to regulate the blast at a furnace according to the volume rather than the pressure. He put his son to work at the furnace, where he had to perform all manner of labor, so that his education in the blast furnace practice was intensely and unpleasantly practical. In 1886 Mr. Kennedy was engaged at the Edgar-Thomson (Carnegie) plant, Braddock, under A. W. Kinsie. After three years Mr. Kennedy entered the laboratory of the Isabella furnaces, and later became superintendent of the Lucy furnaces of the Carnegie Steel Company. The Jefferson Iron Works engaged his services a number of years, and he had charge of the furnace at Steubenville, O. From there he went to Buffalo, N.Y., for the Buffalo Furnace Company. He was associated with Julian Kennedy, his brother, a number of years, and had charge of numerous undertakings for him abroad. Mr. Walter Kennedy went to China for the Cal Brice Syndicate, and while there worked for the Chinese Government. Within the last few years he established an engineering office in Pittsburg, and has had charge of many undertakings, and at present is the engineer for the Cramp-Ontario Steel Company, and has important engineering operations under his direction in Mexico and the United States.

W. A. Fleming & Co., 771 Craig street, Montreal, have secured the order from the Sault Ste. Marie Pulp and Paper Co., for fitting up their sulphite mill with "Camel" brand hair belting, and heavy Empire brand of rubber belting.

A TROPHY OF OIL STONES.



The Pike Manufacturing Company, Pike Station, N.H., sent a handsome exhibit of their goods to the Paris Exposition, where they won a gold medal. This exhibit, shown herewith, consists of over 500 different shapes and varieties of stones for sharpening all kinds of edge tools, and varying in value from sandstone worth 2 cents per pound to the delicate Arkansas oilstone, worth in some shapes as high as $50 per pound.

In the centre of the mahogany booth stands a strong obelisk, on which are artistically arranged a full sample line of various goods made by this company. Surrounding this obelisk, enclosed in a plate-glass case 8 feet high, stands six reeded columns formed entirely of sharpening stones, of which there are five varieties in each column. The color of the stones composing these columns is graduated from a dark steel gray at the bottom to opaque white at the top, giving the exhibit a rich and striking effect. The ornamental sign panels suspended from the top of the booth, the balls at the top of the columns and the finial which supports the trade-mark of the company, namely, a facsimile of a pike fish passing through the loop of the capital letter "P," are solidly gilded. The total height of this exhibit is 21 feet. This booth will be exhibited at the Pan-American Exposition at Buffalo.

CAPT. BERNIER'S TRIP TO THE NORTH POLE.

Capt. Bernier, of Quebec, has returned from London to prepare for his projected trip to the North Pole. Regarding Capt Bernier's plans Chevalier Charles Baillairge, C.E., of Quebec writes the Canadian Engineer as follows: Having fostered the thing and discussed it with him, as a member and past president of the Quebec Geographical Society, and knowing just what Bernier intends doing; I may tell you that so as to work "with nature," as Bernier calls it, and not 'against nature,' as have done all those who like Franklin and so many others, have, travelled eastward towards the pole or in opposition to currents and winds, and ice drift; Bernier instead of going by Nova Zembla, as Nansen did, or by Spitzbergen or Franz Joseph land, will reach the Polar basin by Behring Straits, bringing his vessel as much northward of the position of the Jeannette when it was wrecked, as possible, and northward also of the point at which Nansen abandoned the Fram near the New Siberian Islands. Then leaving the vessel to drift westward towards Spitzbergen with the requisite number of hands on board, he will with the remainder of his crew, including scientists, start on foot across the ice or ice pack for the pole, following a meridian towards it but at the same time crossing more and more according as the drift takes the ice and party eastward of the meridian they start on. If the ice be solid from where they leave the vessel, then of course there will be no drift, and the course will be straight towards the Pole.

The astronomer of the party or scientists charged with that portion of the work, that is, the direction in which it has to travel will have their chronometers with them and their 'Ephemeris' (the 'Nautical Almanac' always ready at Greenwich for some three years in advance) and their other instruments for observations of the sun, and moon and stars, to establish their meridian. The mode of getting a meridian used by surveyors will not be available, on account of the respective distances on opposite sides of the pole of "*Gamma*," of Cassiopeia and of "*Epsilon*," of Ursus Major or first star in the tail of the Great Bear. The party will be north of these stars, and therefore cannot easily bring them with Polaris into line, and even so the stars would be too high in the heavens to determine either a vertical for meridian or a horizontal for elongation.

The process must likely be, though I am not an astronomer, to get a meridian and go towards it till they bring Polaris into their zenith, then knowing how far they are from the true pole of the earth or heavens as equal to the co-declination of the star by the "Ephemeris" this angular distance of about 1° 20' reduced to statute miles (approximately say 93) will show how far they still have to go to reach the goal—the extremity of the axis of the earth, or in other words, until the star during the whole 24 hours is and remains at the required co-declination south of the observers.

That the point can be guaranteed within a foot or so may be doubtful, as even a second of space is about 100 feet on the Earth's surface, and therefore a mere foot, the 100th part of a second: a delicate thing to get at under a freezing atmosphere.

On the return, Bernier will of course make for the vessel and get to Spitzbergen, where he may have to stay over till the first spring vessels from Norway—but—we will await Bernier's own programme of the practical portion of the trip to and from the pole and back, contenting ourselves for the present with this necessary idea of how to know just where the North Pole is, and how to know when they get there. a question which has been a thousand times put to me. The pole is also that point of the Earth's Northern or Southern summit or extremity where the pendulum beats the quickest, but this would be even a more delicate thing to arrive at than the 100th part of a second of space.

Speaking to a Reuter's Agent, Capt. Bernier says—"My second plan, which has already been privately submitted to the Quebec Geographical Society, is to start from Franz Josef Land with a large number of dogs and reindeer and travel during the summer to the Pole by sleighs, taking with me concentrated provisions and killing my reindeer day by day for food. Elaborate calculations have been made as to the number of dogs and reindeer required for sleighing and for food. Travelling at an average of six miles per day, the journey to the Pole should occupy 150 days, at the end of which time I should still have enough provisions to return towards Spitzbergen before winter set in. The point of the whole thing is that I intend to reach the Pole—I say I ought to get there in 150 days, but I have allowed 180 for the purpose. If I leave Franz Josef Land when the sun rises this would still leave (allowing 180 days for the journey) 10 days of remaining light for me to travel towards Spitzbergen. At the expiration of this time I should put myself in winter quarters on the ice, kill the remaining reindeer for food and all the dogs not required for the rest of the homeward journey in the spring. By this means I should hope to reach Spitzbergen in the early summer before the breaking up of the ice. My arrangements are now all completed for the Behring Sea route, and will be submitted to Sir Wilfrid Laurier on my return. I shall take with me from 12 to 14 men—all scientists, and none of them merely sailors or laborers."

BLOWER SYSTEM OF VENTILATION AND HEATING.

The particular features of this combined system of Ventilation and Heating in which a fan is employed to distribute the heated air—are thus summarized in a recent lecture by Walter B. Snow of the Engineering staff of the B. F. Sturtevant Co., Boston, Mass.

"The entire heating surface is centrally located, enclosed in a fireproof casing, and placed under the control of a single individual, thereby avoiding the possibility of damage by leakage or freezing incident to a scattered system of steam piping and radiators. The heater itself is adapted for the use of either live or exhaust steam, and provision is made for utilizing the exhaust of the fan engine, thereby reducing the cost of operation to practically nothing. At all times ample and positive ventilation may be provided with air tempered to the desired degree. Absolute control may be had over the quality and quantity of air supplied. It may be filtered and cleansed, heated or cooled, dried or moistened at will. By means of the hot and cold system the temperature of the air admitted to any given apartment may be instantly and radically changed without the employment of supplementary heating surface."

"The pressure created within the building is sufficient to cause all leakage to be outward, preventing cold inward draughts and avoiding the possibility of drawing air from any polluting source within the building itself. By returning the air using live steam in the heater, and operating the fan at maximum speed, a building may be heated up with great rapidity as is usually desirable in the morning."

"The area of heating surface is only one-third to one-fifth that required with direct radiation, while the primary cost and operating expense of a fan is far less than that of any other device for moving the same amount of air."

J. L. WELLER, C. E., CHIEF ENGINEER OF WELLAND CANAL.

Mr. Weller is an honor graduate of the Royal Military College of Canada. He started in as a rodman in 1882 on the Trent Canal location survey, and has since been continuously in the employ of the Department of Railways and Canals. Was in charge of the construction of the Young's Point dam on the Trent Canal; assistant on the construction of the Murray Canal; principal assistant and afterwards resident engineer on the enlargement of the Cornwall Canal, and engineer in charge of the Port Colborne improvements. The experience gained on these works has embraced almost all of the different problems which arise in canal construction and operation. In 1898 he investigated the cause of failure of the New York & Ottawa Railway bridge across the St. Lawrence. He invented and designed the Weller Launch Motor Reversing Wheel and Pneumatic Diaphragm Pump now being manufactured by the St. Lawrence Motor Co. Limited, Cornwall.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

THE ANNUAL MEETING.

The annual meeting of the above society was held at the society's rooms, 877 Dorchester street, Montreal, on the 24th and 25th January, the president, Prof. Henry T. Bovey, in the chair. The following is a list of members who attended;

Prof. Henry T. Bovey, S. H. Parker, L. G. Papineau, D. MacPherson, C. S. Leech, F. Taylor, F. Crossley, Stuart Howard, R. S. Lea, T. Kirk, J. Ewing, G. Holland, A. Dedman, C. deB. Leprobon, W. McLea Walbank, N. H. Greene, A. J. deB. Corriveau, L. Skaife, J. M. Nelson, S. B. Clement, J. W. Heckman, F. C. Laberge, J. A. Marion, B. D. McConnell, T. W. Lesage, H. Irwin, W. Chase Thomson, G. H. Duggan, G. Legrand, R. B. Kenrick, J. Duchastel de Montrouge, A. Surveyer, E. Malo, E. A. Rhys-Roberts, L. S. Pariseau, W. J. Sproule, L. M. Arkley, W. G. Warner, W. Kennedy, jr., Phelps Johnson, John Kennedy, E. S. Mattice, A. Dubuc, J. T. Lemire, V. Denis, E. C. Amos, F. L. Jermyn, E. Belanger and Prof. C. H. McLeod, of Montreal; Henry A. Gray, Henry F. Duck, Prof. John Galbraith, E. H. Keating, Willis Chipman and M. J. Butler, of Toronto; O. Higman, O. Higman, jr., G. A. Mountain, Chas. H. Keefer, R. Surtees and R. F. H. Bruce, of Ottawa; J. S. Armstrong, Port Hawkesbury, C.B.; J. L. Michaud, St. Anne de Bellevue, Que.; L. A. Vallee and A. Rhodes, of Quebec; N. E. Brooks, Calgary, N.W.T.; O. O'Sullivan, Indian Lorette, Que.; J. E. Sirois, St. Anne de la Pocatiere, Que.; R. B. Rogers, Peterboro, Ont.; W. M. MacPhail, Port Hastings, C.B.; J. H. Sullivan, Valleyfield, Que.; G. K. Addie, Sherbrooke, Que.; T. Monro, Coteau Landing, Que.

The president, Prof. H. T. Bovey, on calling the meeting to order on the 24th January, expressed his gratification at the honor of presiding at the first annual meeting of the Canadian Society of Civil Engineers, held in the new century, and in the new rooms, and expressed the hope that the sphere of usefulness of the society might become broader. He stated that their aim was constantly for progress. He then called upon the secretary to read the minutes

The secretary, Professor McLeod, read the minutes.

The chairman nominated the following gentlemen as scrutineers for the election of officers and members of council: J. Ewing, F. Crossley, S. H. Parker, E. G. Coker, F. Taylor and C. S. Leech.

REPORT OF COUNCIL.

The secretary then read the report of council for the past year, of which the following is an abstract: The elections in the ordinary course comprised five members, seven associate members and twenty-nine students, in all forty-one. One associate has been transferred to the class of honorary member, four associate members to the class of member, and twelve students to the class of associate member. One member, removed from the roll for non-payment of dues, has been reinstated upon payment of his arrears. The elections under the Quebec Act, Vic. 62, Chap. 32, comprised three associate members. One associate has been admitted to the class of member, and one student has been admitted to the class of associate member, under the Quebec Act. Resignations have been received from five students.

There has been one death, L. Jos. Marien, Associate Member. At present the membership stands as follows:

	Non-Res.	Res.	Total.
Honorary members	7	1	8
Members	255	63	318
Associate members	228	86	314
Associates	27	11	38
Students	135	87	222
Total			900

At the same date last year:

	Non-Res.	Res.	Total.
Honorary members	6	1	7
Members	247	61	308
Associate members	198	91	289
Associates	26	14	40
Students	135	87	222
Total			847

There are pending five applications for admission into the society. Thirteen ordinary meetings were held during the year, at which papers were read. Subscriptions towards the fund amounting to $1,153 have been received during the year, and a credit has been placed to the account from entrance fees, amounting to $480. A statement of this fund was appended, showing outlays on the new building to have been $7,480, to help in meeting which $2,600 had been borrowed from the general fund, and $2,000 by a mortgage on the property.

Statement of cost of the building, 877 Dorchester street:

Purchase price of old house and lot	$8,000 00
Expenses in connection with transfer	11 30
Expenses in connection with $2,000 mortgage on property	40 35
Amount of contracts	7,981 80
Amount of extras	850 00
Amount of architect's fees (approximate)	600 00
Amount of new furniture and fittings	127 25
Total	$17,610 70

The year just closed is an important one in the annals of the society, inasmuch as its new building has been completed and occupied, the old premises, 112 Mansfield street, having been vacated on May 3rd last; and also from the fact that a very important summer convention has been held, which, from its success, should justify the annual repetition of such meetings on similar lines in the future.

No further progress is to be reported in regard to legislation.

The Board of Examiners under the Quebec Act, composed of E. Marceau, S. Duval, T. Breen, C. H. McLeod, R. J. Durley and R. S. Lea, held meetings on May 1st and November 6th as required by law.

The council acknowledged the valuable services rendered by the librarian, E. A. Rhys-Roberts, in completing a card catalogue of the pamphlets, and preparing a catalogue of books, now nearly complete, and soon to be published.

The increased membership and the large amount of busi

ness connected with the new house combined to render the office of treasurer during the past year a most arduous one, and that officer was congratulated upon the efficiency of his work.

TREASURER'S STATEMENT, GENERAL FUND.

RECEIPTS AND EXPENDITURE, YEAR ENDING 31ST DEC., 1900.

Balance from 31st December, 1899		$2,869 84
Balance from assistant secretary on 1st January, 1900.		7 59
GENERAL RECEIPTS.		
Subscriptions—		
Arrears	$1,094 50	
Current	3,244 35	
Advance	82 68	
Cheque for 1899 held by bank till 1900	8 00	
Entrance fees	540 00	
Practice fee	40 00	
		$5,009 53
Transactions sold		19 75
1899 dividend Can. Per. Loan Co.'s stock		4 50
1900 dividends Can. P. & W. Can. M. Co.'s stock		10 80
Bank interest on current account		25 27
Bank interest on deposit receipt		21 73
Diploma fee		1 00
Old typewriting machine sold		10 00
Donations to library		16 00
Interest on building fund loan		119 80
		$8,115 81

GENERAL EXPENDITURE.

Loan to building fund	$2,600 00
Transactions printed and published	965 21
Advance proofs	33 00
Printing, stationery and binding	411 68
Charter, bylaws and list of members	122 45
Postage and postcards	291 84
Messengers and telegrams	64 52
Cabs, cartage, etc	19 05
Secretary's salary for year	300 00
Assistant secretary's salary for year	480 00
Caretaker's wages for year	248 00
Keeping rooms open at night until 30th April	56 00
Rent of rooms for six months till 30th April	350 00
Interest on mortgage of $2,000 for six months	50 00
Telephone service for year and repairs	38 45
Bank commission on cheques	4 14
Water rates	20 40
Electric lighting for year ($68.77, 50c. refunded)	68 27
Books, magazines and library expenses	112 23
Expenses re legislation—Quebec province	33 00
Expenses re legislation—Ontario province	8 00
Expenses during annual meeting	7 25
Printing and engrossing diplomas	21 75
Gzowski medal and engrossing	9 25
Office furniture, repairs and house supplies	68 00
Rent of drawer in bank vault for year	5 00
Gas for year	14 60
Entrance fees (less $60 exam. exp.) to bldg. fund	480 00
Treasurer's expenses, car fares, etc	10 00
Examiners' fees	60 00
Insurance, builders' risk	20 00
Insurance on furniture, books, etc.	37 90
Property and school tax for 1899	115 50
Property and school tax for 1900	143 75
Address and photographs to Boston Society of Civil Engineers ($20.60 less refund of $18.50)	2 10
Subscription to Canadian Patriotic Fund	200 00
Coal and kindling wood	122 60
Wiring previous to 1st May	13 50
	$7,616 53
Balance on hand	499 28
	$8,115 81

H. IRWIN, Treasurer.

Examined with books and vouchers and found correct.

JOHN KENNEDY,
DUNCAN MACPHERSON,
Auditors.

Montreal, 21st January, 1901.

The report of the Library Committee was presented by G. H. Duggan, chairman. The committee had held seven meetings during the year. The following code of rules was adopted, relative to the borrowing of books: "Books may be borrowed by any member for a period not exceeding one week. A deposit equal to the value of the book will be required. Should there be a delay beyond one week in returning any book, the borrower is to be charged a rental of two per cent. of its value for each day's delay after the expiration of the week. A limited number of books, which are marked with a star in the society's catalogue, are not to be removed from the library under any circumstances. Periodicals may be borrowed by members for a period of three days on payment of a deposit of fifty cents; a fine of five cents a day is to be charged for each day's delay in returning the periodical after the end of the three days. No periodical may be borrowed till it has been on file in the reading room for two weeks."

"Card playing is not allowed in any part of the building."

Donations to the library have been received from the following: J. Spenard, P. Weatherbee, P. W. St. George, H. L. Shepherd, Dept. of State, U.S.A.; E. A. Rhys-Roberts, Joseph Hobson, Merchants' Association of New York; J. W. Harris, H. W. D. Armstrong, J. D. Mackerras, Owen N. Evans, J. Wiley & Sons, New York, and various pamphlets from other members.

On motion of Mr. Monro, the report was adopted.

The secretary then read the following approximate statement of the society's

ASSETS AND LIABILITIES, 31ST DEC., 1900.

LIABILITIES.

Mortgage on property, 877 Dorchester street	$ 2,000 00
Balance	24,161 43
Total	$26,161 43

ASSETS.

Balance in hand, general fund	$ 449 28
Balance in hand, building fund	100 15
Arrears of fees, $3,560; less 25 per cent. written off	2,670 00
Unpaid subscriptions to building fund	392 50
House, 877 Dorchester street	17,500 00
Books, as per valuation	3,750 00
Furniture, as per valuation	1,250 00
Total	$26,161 43

In the discussion on the report, L. Skaife wanted to know why card playing had been prohibited, and moved a resolution amending this rule, so that it should apply to "gambling" only and not to "card playing." The motion was seconded by W. McL. Walbank, who explained that his object was to elicit the opinion of the society. Messrs. Kennedy, Kerry, Mountain, Keating, Chipman, Hannaford, and Irwin spoke against the motion.

An amendment maintaining the paragraph of the report, as it stood, was moved by Mr. Kennedy, seconded by Mr. Higman. This was carried by a vote of 22 to 9, and Mr Skaife's motion was therefore defeated. The ground taken by most of the speakers was that the society's rooms should not be regarded as a resort for amusement, but for instruction and mutual improvement.

C. de B. Leprohon moved, seconded by R. Surtees, that the rooms of the society be open on Sunday, without requiring the attendance of the secretary or assistant secretary. This was carried, after a discussion, in which Messrs. Irwin and Mountain objected, on the ground that the janitor should not be compelled to work on Sunday.

On motion of L. Skaife, seconded by O. Higman, it was decided to make the time of closing the rooms 11 p.m., instead of 10.30 p.m.

A discussion then took place as to the date and place of the summer meeting. It had been suggested that the meeting should take place at or near Buffalo, so as to take in the Pan American Exposition; and that the time allowed on the excursion tickets might be extended. Mr. Monro and others favored meeting at St. Catharines, which had good accommodation and was within easy reach of Buffalo.

At the afternoon session, the president read his annual

address, which is summarized elsewhere, taking as his subject, "The Place of Science in Education." In opening his address, he paid his tribute to the character of our great Queen, whose death is so universally lamented, and in moving the vote of thanks, Mr. Keating expressed his appreciation of the manner in which the president had given utterance to the general sentiments of the society on the subject of the Queen's death. The vote of thanks was carried amid applause, the seconder being John Kennedy.

On the suggestion of Mr. Kennedy, Prof. McLeod, the president and the proposer, were appointed a committee to draw up a resolution of condolence from the society on the death of the Queen.

Willis Chipman then brought up the subject of lobbying and the acceptance of outside work by salaried engineers and professors of colleges, which he condemned in strong terms, as unfair to the body of civil engineers, who depended on their own professional work and merits for a livelihood.

The president suggested that the proper way to bring the matter before the society would be in the form of a resolution, so that it might receive discussion and be made part of the proceedings. He referred to a letter which had been published in The Canadian Engineer, and said he wished to correct a few wrong impressions which might exist in connection with that letter. It was stated that a professor of electrical engineering had obtained the large fee of $1,750 for testing an incandescent lamp, or perhaps it was an arc lamp. He, himself, thought that $17.50 would be more like the figure.

Professor Galbraith stated that the figures, $1,750, were correct, as he was acquainted with the facts. It was incandescent lights that were tested, and they required special machinery, and it took three months working day and night; but the figures were correct. He stated in connection with Mr. Chipman's remarks, that he felt that it was quite right for professors to be employed wherever they liked to be employed; that that was not a question for the society to decide. If a man wished, and could afford the time to be employed in two different places, he did not see why the society should prevent it.

Mr. Keating was also in favor of an engineer being employed in as many places as he wished, provided he got paid for it. He, however, said that he was very much against any professional engineer indulging in the practice of lobbying.

Mr. Chipman said that he had the papers and proofs in his pocket that certain engineers of the United States were coming to Canada and giving their advice free of charge in order that they might get the work.

A member from Ottawa said he sympathized with Mr. Chipman. He was in a salaried position, and had been asked more than once for advice in respect to electrical works, but had invariably refused, and had directed the enquirers to the technical directories of our engineers, who are not empolyed on salary, in order that they might get the information from them.

Mr. Mountain said that he was glad that Mr. Chipman brought the matter up. He said that the college professor had all the appliances necessary to conduct experiments, which an ordinary practising engineer might not have, and granting that both men might be of equal intelligence, the college professor would be better adapted to carry out the work successfully on account of being better provided with instruments, etc.

Mr. Walbank was also in favor of the college professors doing outside work. He stated from his own personal experience that Prof. Owens, of McGill University, had often done work for him, which he otherwise would not have been able to have done in Canada. Prof. Owens, he said, had done the work much cheaper than they could do it themselves—in fact they could not do it at all.

Mr. Keating thought Mr. Chipman's remarks were far-reaching, bringing up, as they did, four different motions, and the last one, which seemed to degenerate into an attack upon professors of colleges. He said that he did not see that it was any concern of the society whether a man worked for one employer or for twenty. When he was city engineer for Halifax he had an agreement by which his private practice was not to be interfered with.

Mr. Howard said that he was in accord with what Mr. Keating said.

Mr. Chipman said that in his remarks he admitted that college professors should be entrusted with a certain class of work, scientific investigations, testing of electric light, etc., but that they should not act as designing engineers.

The Chairman said the point, if he understood it, was that a salaried engineer may make a report, but he must not do any construction work.

Mr. Chipman thought a salaried engineer should not do construction work except in his own city.

The Chairman said that he sympathized to some extent with what Mr. Chipman said, but that he did not sympathize altogether with the one-sided attack upon the poor college professor. He said that he hoped that Mr. Chipman would move a resolution that a committee be appointed to enquire into the whole subject.

Mr. Chipman—I move that a committee be appointed to draw up resolutions with respect to the matter brought forward in my paper, and that they report to-morrow, if possible.

John Kennedy said that he thought the college professor would be better able to perform his duties by being in touch with practical engineering, as well as with what was going on in the scientific world.

Prof. McLeod said that he thought the time was not far distant when the college board would require the professor to do work outside in order to qualify him to do what he is called upon to do in the college.

Mr. Chipman said the point he made in his paper was that the college professor should not act as a designing engineer in charge of construction independent of any other engineer. The second point he wished to explain was that American engineers should not be encouraged to introduce their methods of getting work in Canada, by means of lobbying.

If they are encouraged, as he knew they were, the only way for a Canadian engineer to secure employment will be to do the same thing. It will be impossible for us to secure employment in a fair way.

Mr. Kerry said that he did not see why engineers should not accept salaries from two cities, if they were able to spare the time to attend to the work of both satisfactorily.

Mr. Irwin thought it was generally understood that when a person is getting a salary he is supposed to devote his whole time to his business; but still that question is not a question between the society and the engineer, but rather between the corporation and the engineer. He did not see that the society had anything to do with it. He said, again, that he did not see why American engineers should not be permitted to come and work in Canada. We profited by their advice and by observing their work. He mentioned an instance, however, against this. A friend of his had told him that when he went to the United States to get employment as an engineer, he did not dare to say that he was a Canadian. On these grounds he thought that American engineers should not be brought here.

Mr. Skaife said that he thought if a committee were appointed to see that American engineers do not practice in the province of Quebec, that the society would be doing better. He knew where there are American engineers doing big works in the province, and they are very busy, and Canadian engineers find it impossible to get a place there.

John Kennedy—And there are Canadian engineers who are very busy correcting the mistakes of some of those American engineers at present.

Mr. Sproule said that he was very glad to hear the remarks, because in former times the college professor was considered as an engineer who did not know anything about practical engineering. He also said that he would like to see some method by which a man's ideas and plans which were made for a corporation should be protected in some way. As it was, when anybody wanted a plan made by any of the corporation engineers, all he had to do was to write for it and get it. Of course, corporation engineers were salaried men, but at the same time he said he would like to see their ideas protected in some way.

Mr. Mountain said it was a matter of common courtesy that corporations exchanged their plans, that they may get advantage out of each other's work.

Prof. Kerry wished to ask Mr. Sproule if all his ideas were protected what would become of the transactions of the Canadian Society of Civil Engineers, which were formed for an interchange of ideas? If Mr. Sproule's suggestion was

adopted, the holding of technical meetings would practically become impossible.

The Chairman observed that the drift of the remarks was to the effect that lobbying is objectionable.

Mr. Chipman—I did not move to that effect. What I moved was with respect to the college professor engaging in private practice. I will give an instance of what I mean. In a certain place I gave plans and reports on a certain work. If I remember right, the amount was something over $400. Now the same work for the same place and under the same conditions was done last year by an American engineer, associated with a college professor, for $75. That is the sort of thing I am meeting in my business, and I know that there are others who are suffering from the same thing.

Mr. Sproule said that was a real grievance, and something should be done in such a case.

Mr. Chipman then moved a resolution requesting the president to appoint a special committee to enquire into specific cases of unprofessional conduct referred to by the mover. The resolution was carried without dissent, and the following named as the committee: Messrs. Keefer, Mountain, Sproule, Chipman, Prof. Galbraith and Dr. Bovey.

L. Skaife moved, seconded by Stuart Howard, that this meeting commend to the incoming council the advisability of appointing a resident secretary, to live in the building, and take the place of the present secretary and assistant secretary; also a cleaner to take the place of the present caretaker. These he said, were merely recommendations for the consideration of the new council. Carried.

FRIDAY, JANUARY 25TH.

On the meeting being called to order, Mr. Keating raised a question of privilege. A resolution had been passed (in favor of which he himself had voted), providing for the opening of the society's rooms on Sunday. A number of members since expressed themselves in strong terms on this, and it was felt that to pass such a resolution at a moment when only a few members were present, and without knowing the opinion of outside members, was not wise. He moved that this resolution be rescinded, and the question submitted to a general vote of the society. This was seconded by Mr. Monro and carried by 14 to 6.

The report of the council committee was presented, and the cement committee reappointed.

The Gzowski medal committee reported that the Gzowski medal for the best paper during the year was awarded to Stuart Howard for his paper on the "Construction of the Ontario and Berri Street Subways, Brock Street Tunnel, and Notre Dame Street Viaduct," of Montreal.

A vote of thanks was passed to Mr. Irwin, for his services as treasurer, and it was decided to employ a chartered accountant to assist him in his work.

On motion of Mr. Kirk, seconded by Mr. O'Sullivan, the incoming council was requested to ask the railway companies for commercial travelers' rates for members of the society.

ELECTION OF OFFICERS.

The election of officers was then proceeded with, and resulted as follows: President, E. H. Keating, Toronto; vice-presidents, G. H. Duggan, E. Marceau, Montreal; C. H. Rust, Toronto; treasurer, H. Irwin, Montreal; secretary, C. H. McLeod, Montreal; librarian, E. A. Rhys-Roberts, Montreal; members of council, John Kennedy, Montreal; W. P. Anderson, G. A. Mountain, Ottawa; D. MacPherson, Montreal; P. S. Archibald, Moncton; H. J. Cambie, Vancouver; W. R. Butler, Kingston; Prof. J. Galbraith, Toronto; James Ross, Montreal; H. S. Poole, Halifax; R. B. Rogers, Peterboro; R. Hering, New York; Willis Chipman, Cecil B. Smith, Toronto; B. D. McConnell, Montreal.

Mr. Keating, on taking the chair, expressed his thanks for the honor done him in electing him president.

Mr. Sproule then said that he wished to withdraw his name from the committee appointed to consider Mr. Chipman's charges about the practice of engineers' lobbying; and he also proposed that Mr. Chipman be replaced on that committee. He considered that as that gentleman had brought the charges forward, he would be in the best position to see that justice was done to them. He also suggested that Mr. Lea be placed on the committee. This was seconded by Major Gray.

Mr. Chipman said he thought that probably it would be better if his name was left off the committee; but that he would like to see the name of somebody interested in the same particular class of work as he was.

Prof. Bovey said that the committee was appointed with power to add to their number, so that it rested entirely with the committee both as to their number and as to where they would meet.

Mr. Sproule said that on account of all the trouble there had been in connection with the ballots last year, it would be better to keep them for a while, in case that any question might arise.

He moved, seconded by Mr. Walbank, "that the ballots be retained for three months, and then destroyed." Carried.

The convention then closed, the members having decided to forego the annual dinner, owing to the death of the Queen.

E. H. KEATING, PRESIDENT CANADIAN SOCIETY OF CIVIL ENGINEERS. A BIOGRAPHICAL SKETCH OF MR. KEATING APPEARED IN THE CANADIAN ENGINEER IN MARCH 1896.

F. H. CLERGUE AND THE INDUSTRIES OF SAULT STE. MARIE.

A few years ago, F. H. Clergue, a native of Bangor, Maine, and living in New York, went west to look up for some Philadelphians a water power that could be improved and sold as electrical energy. At the lower end of Lake Superior he saw an opportunity to develop an immense power, and his people began work. They bought a canal built by the town of Sault Ste. Marie, Ont., that furnished them 20,000 h.p., but when they wanted to sell their power they found no takers, so made up their minds to use it themselves, and find a means of development. Then the genius of Mr. Clergue came into play; he had already bought the American canal for 25 cents on the dollar, that being at the time its actual value to him, he also took over the Canadian canal, and generously paid the citizens of Sault Ste. Marie all the money they had put into it, some $265,000; but now as he found he could not sell the power, he determined to use it. All about the Canadian "Soo," north as far as Hudson Bay, and east and west, are vast forests of spruce, the ideal wood for paper making. Mr Clergue therefore proceeded to construct a pulp mill; by the agreement with the Ontario Government the construction work was to cost not less than $250,000, but he found that it was too small to pay, so enlarged it from an output of 20 tons a day to 150 tons a day; this is one of the largest pulp mills in the world, and is now making a product that sells for $900,000 a year. It fixes the price for paper in all the American West; and ships to points ranging from Japan to Europe. As proof of this Mr Clergue recently stated that in one mail the other day came an order from the American paper-making region at Menominee, Wis., another from Nagasaki, Japan, and a third from France. A very large share of the mill's product for the past few months has gone to France and Germany. But the

success of this mill, says an article in the Algoma Pioneer, from which much of this information is taken, was not achieved without a struggle. When it was built all wood pulp was shipped from the mill to the paper machines wet, and there were paid freight charges on about fifty-five per cent. of water. This limited the range of shipment. The new company experimented and found a process by which it could dry the pulp. Since then the field of shipment has been limited only by the demands of the paper trade. While mechanical pulp is worth $30 a ton, sulphite pulp, wood treated mechanically, is worth nearly twice as much, and the company with its unlimited supply of the best wood in the world decided to make this also. So now the largest sulphite mill in the world is nearing completion. Its product will be worth $1,500,000 a year. But for the sulphite pulp sulphur is necessary. At the great Sudbury works of the Canadian Copper Company they are pouring into the air a thousand dollars daily of sulphite fumes. Sudbury is two hundred miles from the Sault, and produces the bulk of the world's nickel. The nickel ore mined there is what is called a nickeliferous pyrrhotite, and contains nickel, sulphur and iron. At the matte furnaces of the Canadian Copper Company they were saving the nickel, but the sulphur and iron were thrown away. Mr. Clergue's experts found a way to save the sulphur and are now, they say, making a commercial product from the roasting of pyrrhotite. Chemical experts over the world will not believe this possible until they see it done on a commercial scale, and this Mr. Clergue says will occur in a few months, as soon as the reduction works now under way are completed. So Mr. Clergue's company bought a nickel mine near Sudbury for the sulphur and is now building the Manitoulin and North Shore Railway to and through the rich nickel belt, and on to Sault Ste. Marie.

Mr. Clergue instead of sending to Sicily for his sulphur, roasts it out of nickel ore and then smelts the ore into ferro nickel pig iron, and that is refined into ferro-nickel steel. There being a super-abundance of the valuable nickel in the ore (it containing 7 per cent., where only 3½ per cent. is required), "red hematite" was needed, and the "Helen" mine was found not far away. This mine has now shipped its first ore, which has been tested successfully in furnaces. It is a vast quarry of high-grade iron ore, suitable for the manufacture of steel, containing at least 30,000,000 tons and perhaps more; no one knows how much.

With the extraction of the sulphur from the pyrrhotite there was left a ferro-nickel ore, whose possibilities for the manufacture of nickel steel were alluring, at least, so thought Mr. Clergue, and he set about utilizing it. Furnaces were devised that, to the extent of a five-ton unit, smelted this soft, high nickel ore into a nickel steel, sufficient iron ore being added to the mixture to make a hard steel. The nickel percentage of the ferro-nickel was so great that the resulting steel was very soft, it being a peculiar feature of nickel that an admixture of more than five or six per cent. of nickel, or thereabouts, make an armor plate. The company has a very large machine shop, and all the hard cutting tools used there are made of its own nickel steel, smelted in its own furnaces by electricity. The plans for the ferro-nickel works, which are now under construction, propose one hundred furnaces, of five tons daily capacity each. The company has closed a contract with the Krupp firm of Germany, under which a large amount of this nickel steel will be manufactured at the Sault, and shipped to Germany for a period of five years. Under this contract, no metal has yet been delivered, and none may be sent for a year, but samples have been shown to the Krupps, and Mr. Clergue states positively that the contract is closed and will be carried out. But while all this was going on Mr. Clergue was not losing sight of the transportation problem, as nothing can be carried to a successful issue without railroads; so three main lines, not counting branches, are now being constructed, located, or contemplated by the same Mr. Clergue, who saw the possibilities of the Lake Superior mill-pond, and has ever since been engaged in turning the possible into the actual. The first is the "Algoma Central," to run back to "Missanabie," on the main line of the Canadian Pacific. The second will extend the "Algoma Central" to the salt water of James Bay, the pocket of Hudson Bay, which bends down to within 300 miles of Missenabie; the third will connect the Sudbury region with the Great Manitoulin Island, crossing the north channel of the Georgian Bay at Little Current. Each of these promises to impart new life to large and hitherto hermetically sealed districts of the province. The first fifty miles of the Algoma Central are nearly finished, and it is being pushed to completion, and so strong is the faith of Mr. Clergue in the future of "New Ontario," that he has agreed on the part of his company (subject to their ratification), with the Government of the province to place on their lands or the lands of the Crown adjacent to their line, one thousand male settlers annually, for the next ten years. In consideration of this and other covenants they are to receive in fee simple 7,400 acres of land for every mile of the 200 they are constructing to Missenabie. The necessity of building the line to Missenabie is apparent, but the road is to be pushed 300 miles further north, as it is claimed that the areas of pulp wood and of mineral bearing rock are more promising on Hudson's Bay than on the Lake Superior watersheds, and besides the salt water sea is there, and that means fisheries at a distance of 500 miles from the Sault; whence fish can be shipped to Chicago on one side and St. Paul and Minneapolis on the other. Salt water fish are now carried to these markets over 2,000 and 3,000 miles of rail. How can Atlantic fish compete with these when once the 500 miles of iron road has been built.

"In five years," says Mr. Clergue, "we will be running through fish trains from Hudson Bay to Chicago." In five years, too, the company will have absorbed all the outflow of Lake Superior, except what was needed for vessels. One canal to give 20,000 h.p. is now in operation, another to give 50,000 h.p. is almost completed, on the Michigan side of the river. Of the total power, 40,000 h.p. has been leased for a long term of years, to the Union Carbide Co., and the United Alkali Co. The former is now using a great power at Niagara, for the manufacture of carbide of calcium. The Sault power will cost it perhaps, a third of what it pays at Niagara, and yet the development concern will, in twenty-five years get back all the original cost, as well as an annual interest. Some 10,000-h.p. on the Michigan side, will be used in the reduction of copper from that State, and for other natural uses. A few weeks ago, work was begun on the Canadian side of the river, on a second canal, that is to develop 40,000-h.p. more. It is estimated that this will take all the power of the river. The Michigan canal is to be furnished with 320 turbine wheels, each four harnessed to one great single-phase dynamo, the whole to generate 50,000 h.p. The contracts for wheels and generators have been made, and the canal is being pushed with 1,000 men, and all the steam and compressed air appliances that can be assembled. It is a cutting two and a half miles long, two hundred feet wide and twenty-two feet deep, through the heart of the city, and much of it in solid rock. The sides are cut by air channelers from the solid rock ledge, and the waste material is used in erecting the great buildings. There will be a power house 1,380 feet long, 100 feet wide and 100 feet high. This canal and power plant will have cost, when done, $2,750,000. The second Canadian canal will cost nearly as much.

Next year the company intend to have four more ships now building in England), and similar to those in use during the past season, and Mr. Clergue says that work can be found for the fleet of eight, and more, too, Such is a short outline of what can be done by such a man as F. H. Clergue, with brains, ability and pluck, and the motto is amply verified, "He came," "he saw," "he conquered."

The very latest in connection with the many schemes of Mr. Clergue and the development of the resources of Sault Ste. Marie is the asking for legislation from the Dominion Parliament for and on behalf of one of his railways, the Algoma Central; this company are seeking parliamentary power to enter into an agreement or agreements with the Canadian Pacific, the Grand Trunk, the Lake Superior and Hudson Bay Ry. Co., the Ontario, Hudson Bay & Western Ry. Co., and the Manitoulin & North Shore Ry. Co., for authority to amalgamate with any or all of them, and for a declaration that the company always has had power to issue its notes, bonds, debentures or other securities for the purchase of vessels and water craft, in addition to the securities that it has been authorized to issue for the construction of its line or lines of railway, for power to extend its line of railway from a point on the main line of the Canadian Pacific Ry., thence northerly to some

point on James Bay in the province of Ontario, and to change the name of the said company to the Algoma Central and Hudson Bay Ry. Co. He and his associates are also applying to Parliament for an Act to incorporate the Clergue Iron and Nickel Steel Co., of Canada, for the following purposes: The manufacture of iron, steel and nickel, and dealing in these articles; to acquire and operate coal, iron, nickel and other mines, timber limits and other sources of fuel supply; to acquire, construct and operate furnaces, foundries, rolling mills and other machinery, appliances and works for the treatment of ores and metals under all forms; the manufacture of charcoal and by-products, and the dealing in wood and products thereof; the manufacture of coke and by-products; to carry on the business of engineers and contractors for the manufacture and building of iron and steel railway and highway bridges, cars and locomotives, buildings and other structures; to build, own and operate ships, tramways, telegraph and telephone lines, piers and wharves; to acquire patent rights, water powers and lands, with power to build, construct and equip sidings and spur lines to and from the mining properties, works, yards and wharves of the company, to connect with any other line or lines of railway built or to be built, and such other powers under the railway act as may be necessary, and for other purposes. The operations of the company will be carried on at or near Sault Ste. Marie, and at or near the city of Quebec.

Mr. Clergue has also recently purchased the Gertrude mine, fourteen miles southwest of Sudbury, and has already done considerable development work upon it, so much so that to-day the mine is practically in a position to ship ore. Mr. Clergue, however, is waiting till his railway, the Manitoulin & North Shore Road, which runs past the mine, is constructed, so he can ship the ore cheaply and easily to Sudbury, and from there to the Soo, where he proposes to treat it himself. The Manitoulin & North Shore Railway runs from Levack, on the main line of the C.P.R., to Little Current, with a spur into Sudbury. The track is now almost completed between Sudbury and the Gertrude mine, and this month will probably see it completed.

NEW BRIDGE COMPANY.

On November 28th, 1900, Ontario letters patent were issued incorporating the Canadian Bridge Company, Ltd., with a capital of $250,000. The stock of the company is fully subscribed by Detroit, Walkerville and New York capitalists. The present officers are: President and engineer, Francis C. McMath; secretary and treasurer, Burnham S. Colburn, who are well-known in the bridge-building business in Canada, having been prominently connected with the building of the new Victoria bridge at Montreal, and many other important structures in Canada. The Canadian Bridge Company, Ltd. has just put into operation their new shops at Walkerville. Their main shop is a steel frame building, especially designed for the manufacture of railroad and highway bridges and structural work, and is 101 feet in width by 560 feet in length. The equipment of the machinery is of a most modern character, and is capable of turning out 1,000 tons of finished product per month. The new company has opened an office in the Temple Building, Toronto, with Henry F. Duck in charge as resident engineer.

ENGINEERS' CLUB, TORONTO.

At one of the regular meetings of the above club last month an interesting talk on cement, led by M. J. Butler, took place, notes of which will be given in another issue.

At the meeting on the 5th inst. an interesting exhibit of photographs was made by members who filled the walls with pictures of interest to engineers.

On the evening of the 21st February a lecture with stereopticon views will be given by Prof. C. H. C. Wright on "Architectural Photography."

The following is a full list of the officers of this club including members of the standing committees. President, A. L. Hertzberg; vice president, Major H. A. Gray; directors, T. R. Rosebrugh, Jas. McDougall, C. B. Smith; secretary, Willis Chipman; treasurer, C. M. Canniff. Finance Committee, H. F. Duck, chairman; A. F. Macallum, Capt. Gamble, A. B. Lambe. Room Committee, R. A. L. Gray, chairman; J. H. Chewitt, E. J. Philip, A. E. Wallberg. Library Committee, W. H. Patton, chairman; W. A. Clement, R. F. Tate, L. B. Stewart.

LITERARY NOTES.

The "works management" number of the Engineering Magazine contains no less than 634 pages, and is said to be the largest single issue of any magazine of any kind ever published in the history of the world. It deals with the science of organization, management and mechanical equipment, and describes the methods of the world's foremost industrial managers.

The 1901 issue of The Canadian Almanac, the fifty-fourth annual issue, is unusually valuable, and is indispensable to every office and library in the Dominion. Many of the lists given are not found elsewhere, and in no other volume can so much information about Canada be found in so small a space. The Copp, Clark Co., Ltd., publishers. Paper edition, 25 cents; cloth, 50 cents.

The Power and Lighting Economist is a technical magazine, having its birth in the first month of the new century. It is published quarterly by Frank H. Knox, Troy, N.Y., at $1 a year. The first number contains 68 pages of interesting reading matter.

The Western Electrician's first number of the new year is a souvenir issue enclosed in an illuminated cover. The first page contains an interesting group of portraits, including Volta, Ampere, Ohm, Oersted, Faraday, Henry, Siemens, Maxwell and Hertz.

The Marine Review, of Cleveland, O., for February 7th, is a "ship building edition," containing among other features a list of vessels under construction by the United States Navy, and a list of merchant vessels now building in American shipyards. From these tables it appears that there are in all 61 war vessels, of which 10 are battle ships and 9 cruisers, under construction at a cost of over $80,000,000. There are 36 steel vessels being built by the American Ship Building Co. in their different yards on the Great Lakes, and 25 vessels, of which all but 6 are steel, in the yards of other companies. There are also about 250 being built in the yards along the Atlantic and Pacific coasts.

The publishers of Power, New York, have issued a special number devoted to gas engines. It contains 67 pages, 8 x 11, and the price is 25 cents.

The report of the 10th convention of the Association of Railway Superintendents of Bridges and Buildings is issued from the Rumford Press, Concord, N.H. It makes a volume of 303 pages.

The Complete Cost-Keeper is a valuable new work compiled by Horace L. Arnold (Henry Roland), and published by The Engineering Magazine of New York. It is a cloth bound volume, 408 pages, and contains sample pages of the best systems of shop cost-keeping and accounting, with an exposition of the card system of accounts. It gives systems for small concerns as well as highly organized establishments, and covers the ground more completely than any work of the kind we have seen.

The British Columbia Mining Record, Victoria, B.C., issued a very instructive Christmas supplement, containing much information and many half-tone illustrations of the mining scenes in the prosperous Pacific province. H. Mortimer Lamb is editor.

A pamphlet is just issued by J. S. Bache & Co., 66 Exchange Place, New York, entitled "American Industrials, with Special Reference to the Preferred Shares as Investments." It contains descriptions of the organization, financial condition and other salient facts of thirty industrial companies and trusts, among which are the American Car & Foundry Co., American Sheet Steel Co., American Smelting & Refining Co., American Steel & Wire Co., American Steel Hoop Co., Federal Steel Co., General Chemical Co. and General Electric Co.

The Engineer, 33 Norfolk street, Strand, London, Eng., has issued a new edition of its directory of advertisers in that journal, the pamphlet also containing a partial index of leading articles that appeared during the past year.

There are a good many South African war books in the Canadian market, and more to come. Of all we have seen there is none that stands any comparison with the comprehensive work prepared under the auspices of the London Times by that journal's own correspondents and others, and published in five or six volumes by Sampson, Low, Marston & Co., London, whose Canadian agents are the Copp, Clark Co., Toronto. The first volume of 302 pages, to which we shall refer again, has been issued and gives promise that the work will be the standard history of the war.

The Universal Electrical Directory for 1901, just issued, comprises the names and addresses of the members of the electrical and kindred industries throughout the world. The book has been most thoroughly revised, and the British alphabetical section now comprises about 10,656 distinct names; the Continental, 9,240 names; the American, 6,160, and the Colonial, 2,530; a total of 28,586, or 2,189 names more than in the book for 1900. In addition to the new names in the present issue, much financial information is given, the telegraphic addresses and local telephone numbers are given. In all there are about 1,250 pages of directory matter. Besides being the largest, it is also the oldest electrical directory in the world. The price is $2. H. Alabaster, Gatehouse & Co., publishers, 4 Ludgate Hill, London, England.

The American Railway Engineering and Maintenance-of-Way Association, now in its second year, has just issued a bulletin on "Locomotive Tonnage Rating," which does the association credit, and is an earnest of the comprehensive treatment which other lines of railway maintenance and operation may expect to receive by the hands of the association in due course. The bulletin is a statement of the methods of locomotive tonnage rating as worked out and adopted on the Pacific system of the Southern Pacific Railway Co. by its officers in charge of these questions. The subject matter of the bulletin is interesting, aside from its intrinsic merit to those who are similarly engaged and can make use of the information contained, in that it bases the treatment on that of the late A. M. Wellington's, whose genius is becoming more and more recognized by railway engineers; and this will, perhaps, induce many to re-read his great text-book on "Railway Location." The application of mathematics and brains to economic transportation is increasing every day, and has produced wonderfully low rates for long haul material, such as has recently been obtained on the Chesapeake and Ohio Railway, and we may expect great changes in this respect for many years yet, as the funds for improving ruling grades are available. The possibilities of improvement in this respect are greater than by increasing the weight of locomotives and cars, which have practically reached the limit of economy in this respect.

The development of the mining industry in Ontario and the consequent extension of mining operations have led to a largely increased use of dynamite and kindred explosives. Too often these dangerous substances have been handled carelessly or recklessly, or by men unacquainted with the safest and most economic methods of using them. The result has been an undue number of severe and fatal accidents as well as waste of material and greater cost of working. In order to disseminate as widely as possible a better knowledge of explosives and their employment, and thus reduce the risk to the working miners of the province, and promote efficiency of blasting operations, the Bureau of Mines has just issued a pamphlet of 126 pages, dealing with this important subject. The author is Prof. Courtenay DeKalb, of the Kingston School of Mining, who is also Inspector of Mines for Eastern Ontario. The Commissioner of Crown Lands is taking steps to place a copy of this work in the hands of every mine and quarry manager, captain and foreman in Ontario, free of charge, in the hope that a perusal of its contents may lead to a diminution in the number of accidents resulting from the use of explosives. Other persons may procure a copy for the nominal charge of 25 cents on application to the undersigned. The motive of this manual is creditable to the provincial government and the hand-book covers the ground very completely.

PUBLICATIONS RECEIVED.

Proceedings of Lake Superior Mining Institute, sixth meeting.

Report of Committee on Protection of North American Birds for 1900, with notes on results of the special protection to gulls and terns, obtained through the Thayer Fund for that purpose. By Witmer Stone and Wm. Dutcher, of the American Ornithologists Union. Reprinted from "The Auk," 525 Manhattan avenue, New York.

Roman Stone Arches, being part II. of Engineering Studies, by Charles E. Fowler, C.E.; illustrations of eight celebrated Roman bridges with a few notes on each; 16p. Engineering News Publishing Co., New York.

Canadian Rand Drill Co., description of new shops at Sherbrooke, Que., with four tinted photo-engravings of these large works.

Annual report of waterworks and sewage disposal works, Hamilton, Ont., for 1900; 48 pp.; illustrations and two maps.

International Correspondence Schools, Scranton, Pa. Pamphlet of testimonials of "Students' Aid Department." Also from same institution pamphlet, "Salaried positions for learners."

Annual Report, Board of Trade, Vancouver, B.C., 119 pages, illustrated.

Annual Report, city engineer, Toronto, for 1899; 195 pages, maps and plans.

Duty of Water in Gallatin Valley, by Samuel Fortier, C.E., of Montana College of Agriculture, U.S. Department of Agriculture, Elwood Mead being the expert in charge of irrigation investigations.

NEW CATALOGUES.

"Bundy Separator" is the title of a neat 32 page catalogue, which sets forth with the aid of beautiful cuts and clear description the merits of the Bundy steam and oil separators. These 32 pages are a section of a 100 page catalogue, in which is described a full line of Bundy steam specialties, comprising steam traps, separators, feed water heaters, low water alarms, exhaust heads and boiler covering. The manufacturers, A. A. Griffing Iron Company, 66 and 68 Center street, New York, will mail a copy to those interested.

ANOTHER PROCESS FOR SAND BRICKS.

Editor CANADIAN ENGINEER:

SIR,—I read with interest your reply to a correspondent regarding the manufacture of sand brick, wherein you stated that brick made from sand could not compete successfully with brick made from clay.

It is my own humble opinion, and I have it on the authority of gentlemen who have studied this subject in all its phases, both in Canada and the United States, during the past five months, that the manufacture of sand brick will be in successful operation within a period of 12 months from date.

The material used in the process with which I am familiar, is described as "Petrified Chemical Sand," and the bricks produced from this material have a high crushing strength, and are equal in appearance and durability to the best pressed brick manufactured to-day.

I designed recently a machine for this process which is being built in the United States, the capacity of which is 20,000 per day of 10 hours, and have since designed and patented a more simple machine for making brick of any required shape from this material.

The pressure required is not in excess of that used in the manufacture of the pressed brick with which we are now familiar, and I may state that the success of this process is assured from the fact that no artificial drying of the brick after pressing is required, thus greatly reducing the cost of manufacture, doing away with kilns, fuel, extra labor, etc., and at the same time producing a brick equally as good as the article now in daily use

T. W. ATTERBURY, M.E.

—Under the head of "Newspaper Gossip and Comment" the following occurs in the Inland Printer for January: "J. H. Brown, Canadian Engineer, Toronto, Canada. Your magazine compares favorably with first-class trade journals its large amount of advertising being well handled."

Marine News.

M. Beatty & Sons, have the contract to rebuild one of Hogan & Macdonald's dredges, now at Port Colborne, Ont.

The contract for the new tug for Mr. Pilgrim, of Meaford, Ont., has been awarded to Robert Morrell, Collingwood, and will be 70 feet in length.

The Hamilton Bridge Co., has contracted to build a steel tow barge, 200 feet in length, for the Montreal Transportation Company.

The new R. & O. steamer, "Kingston," whose dimensions were given last year, was successfully launched on January 19th, at Toronto.

The Peterboro Navigation Co. will, next season, place a freight boat on the route between Heeley's Falls and Peterboro, and a passenger steamer on the Hastings route.

Pearson & Burrill, of St. John, N.B., are promoting a company to build steel ships in that city. Hon. A. G. Blair is said to have given assurances of help from the Dominion Government.

The British Columbia Government's offer of a subsidy to vessels built and owned in the province, is already bearing fruit. It is announced that eight schooners for the lumber trade are to be built at Barnet, B.C.

Potter Bros., Canning, N.S., are building a steamer 105 feet long to replace the "Beaver." It will have accommodation for 24 passengers, and cargo capacity of 1,200 barrels, and will be ready for service by July 1st.

Application will be made to the Parliament of Canada to incorporate "The St. Lawrence Lloyd's," for carrying on an ocean and inland marine insurance business, with the right to navigate ice breaking steamers on the St. Lawrence.

A. W. Nordin, contractor for the ice crushing vessels to run between Montreal and Quebec, has gone to France to oversee their building; they are of the "Ermack" type. The St. Lawrence River Navigation Co., who propose to do this work, are capitalized at £500,000.

Davis & Son, of Kingston, Ont., have commenced to build a new steamer for J. A. Roys, of the Cornwall Oil Co. to ply between Cornwall and Massena. She is to be 112 feet long, and 21 feet beam, with Clyde boilers, and compound engines. She is to be ready in June next. She will be a day excursion boat of a speed of 14 miles per hour.

The Dominion Government are having a new steel ferry built at Newcastle-on-Tyne, England, to take the place of the old one at the Straits of Canso; this is made necessary by the increasing business on the I.C.R. She will cost $250,000, and will be of 2,000-h.p., and be able to carry a locomotive and four cars each trip.

The C.P.R. have sold the four large steamers built in 1898 for the Klondyke trade by the Stikeen river route. Since they were built they have never been utilized by the company; three of them have been tied up at the wharf at Wrangel, and the fourth at Vancouver. Their names are the "Hamlin," "Dawson," "McConnell," and "Ogilvie." The White Pass and Yukon Railway Company are the purchasers, and intend to renovate and fit them up this winter, and in the spring place them on a regular service between Vancouver, Victoria, and Skaguay, thus giving the W. P. & Y. Co. a complete line of transportation from British Columbia ports to Dawson City.

The establishment at Halifax, N.S., of a big steel shipbuilding enterprise is being agitated. The Board of Trade favored giving a bounty of $2 per ton on every steamer built, for the first period of five years, and of $1 per ton for the next five years. The City Council was willing to grant a subsidy of $6,000 a year, if the proposed shipyards were constructed, and an additional subsidy of $4,000 a year if the establishment include boiler and engine works. The city's subsidy would be for a period of twenty years. The promoters say that the steel shipbuilding works they propose at Halifax will be as large as any in the world. They would build freight and passenger steamers.

Industrial Notes.

A new binder twine company has been formed at Chatham, Ont., with a capital of $125,000.

The Crescent Mill and Timber Co., London, is now being operated by F. G. Rumball, mayor, proprietor of London Box Co.

The Sutherland-Innes Co., Ltd., Chatham, Ont., is erecting a new stave mill at Denfield, and also one at Castleford, Ontario.

Francis Blaikie, Sarnia, has sold out his machinery to the John Goodison Thresher Co., and it has been moved to their works.

The Raymond Mnfg. Co., Guelph, have erected a large new building adjoining their works, to manufacture cream separators.

The Sanitary Dairy Co., Ltd., London, Ont., with capital of $100,000, is putting up a large building in the central part of the city.

Sherbrooke, Que., proposes to build a new city hall this year, and is asking the Quebec Government to go on with the proposed court house.

The first cast of pig iron at the new works of the Dominion Steel Company took place at Sydney on the 4th inst. About thirty tons were produced.

The Hamilton Facing Mill Co., whose serviceable calendar was acknowledged last month, have completed their 10th year, the most successful one in the firm's existence.

In the item in last number referring to the Syracuse Smelting Co.'s Aluminum Babbitt metal, the phrase best "boring metal," should have read best "bearing metal."

The Malleable Iron Co., of Walkerville, Ont., has during the past year added an extension and a wing to its works equal to a building 1,000 x 60 feet. The output of these works last year was 4,400 tons.

The attention of mechanics and engineers is called to the announcement in another column of the Free Scholarship offer made by the American School of Correspondence.

T. M. Davies & Co., owners of the big iron works in Honolulu and Liverpool, have purchased the iron works of Armstrong & Morrison in Vancouver for $250,000. It is said they will spend $150,000 in new machinery, and will employ 250 men.

An association for the promotion of the beet root industry in Ontario has been formed, with the following officers: President, John Parry, Dunnville; first vice-president, J. M. Shuttleworth, Brantford; second vice-president, B. B. Freeman, Wiarton; third vice-president, T. A. Smith, Chatham; fourth vice-president, W. S. Caron, Aylmer; sec.-treas., D. H. Price, Aylmer.

The Canada Foundry Co., of Toronto, controlled by the Canadian General Electric Co., have taken an important step in the purchase of two blocks of land, 30 acres in extent, on which extensive new foundry and machine shops will be built this year. The land is admirably chosen for the purpose, being located off Davenport Road at the crossing of the G.T.R. and C.P.R., with direct access also to the street railway system.

Wm. Morris, Toronto, is applying for a charter for the International Bridge Co., to build a toll bridge over the St. Mary river, near Sault Ste. Marie; capital stock, $500,000; the bridge is for electric cars, pedestrians and vehicles, and to carry gas pipes, wires and cables for electricity, etc. Arches to be not less than 40 feet high; span between piers 200 feet, with a draw or swing over the Canadian ship canal.

Geo. White & Sons have erected two large additions to their agricultural engine works at London, Ont., during the past year. They are now bringing out a machine new to the Canadian market in the shape of a corn husker and shredder. By the rapidity with which it husks the corn and shreds the stalks into edible food for cattle, it will enable a farmer to take care of a much larger acreage of corn than was possible by hand labor.

W. A. Brewster, Edmonton, has started a foundry in connection with his machine shop.

The sewage committee of Fredericton, N.B., recommends a new system of sewage at a cost of $80,000.

John Breakey, the large mill owner, is to erect a pulp mill at Chaudiere Falls, Levis county, Que., in the spring.

Hanover, Ont., has offered the Knechtel Furniture Co., a bonus of $25,000 to rebuild his furniture factory there.

The Stevens Mnfg. Co., London, Ont., brass founders, have suspended, owing to the refusal of the firm's bankers to make accommodations.

The Chatham, Ont., Binder Twine Company has been formed with a capital stock of $125,000. A factory with a capacity of five tons a day will be erected at once, and will employ about 50 hands.

The King Shirt Co. has been formed at Belleville, to manufacture men's shirts, collars and cuffs. The manager is A. E. Fish. The factory, which will have a steam plant, is to be in operation in a few days, starting with about 75 hands.

The Union Paper Machine Co., manufacturers of paper-making machinery at Fitchburg, Mass., have been visiting Sherbrooke, Montreal, and the St. Maurice district, looking for a site for a proposed branch works in Canada.

Chas. L. Meyer reports that he has secured Chicago capital for the proposed smelter at Kingston, and that not only will this work soon be commenced, but a roaster for sulphuric ore, and a lead smelter will be erected to be followed by rolling mills.

In consequence of the burning of the Board of Trade Building, Montreal, A. C. Leslie & Co., metal merchants, have moved their office to the Merchants' Bank Building; and J. A. Jamieson, engineer and contractor, has moved to 75 Common street.

The Association of Ontario Land Surveyors will hold its annual convention in the basement of the parliament buildings, Toronto, on the 26th February, and following days. The Engineers' Club of Toronto has offered the association the freedom of its rooms.

The Montreal Cotton Co. will erect another cotton mill at Valleyfield, Que. There will be two buildings, one devoted to spinning, and another to weaving. There will be 38,000 spindles and 850 looms. Most of the cotton machinery has been purchased in England.

The Dominion Cordage and Manufacturing Co. is formed with capital of $400,000; head office, Peterborough. Directors: Adam Hall, J. Armstrong, G. L. Hay, J. A. Bennett, and J. L. Latimer, Peterborough. The company propose to manufacture cordage, rope, binder twine, etc.

At a meeting held the other day, in Ottawa, the Keewatin Power Co. decided to go ahead with the building of a pulp mill having a capacity of 100 tons per day. Alex. Fraser, Ottawa; A. MacLaren, Buckingham, Que., and Wm. Gibson, Beamsville, are directors of the company.

The Spanish River Pulp & Paper Co. have already installed a brick-making plant for their own buildings, and during the summer will employ 200 men on the works, on which over $200,000 will be spent. Some of the pulp machinery is being made at Sault Ste. Marie.

M. Beatty & Sons have completed their shipyard on the canal bank. They have erected there a large frame building, and two steel travelling cranes. The plant will be operated by two steam engines. The plant together with the new tools necessary for this work cost several thousand dollars.—Welland Tribune.

E. Leonard & Sons, engineers, London, Ont., are installing a Lancashire boiler 7 feet in diameter, and 30 feet long in the H. W. McNeill colliery at Anthracite, N.W.T., and a Scotch boiler in one of the mines of the 20th Century Trading Co., in the Rainy River district. They are also supplying two high-speed engines, one of 150-h.p. and one of 100-h.p., to the Kingston penitentiary, and a 200-h.p. high-speed engine for lighting the mines of Ludwig Mond, at Victoria Mines, Ont. Messrs. Leonard & Sons are preparing a large new catalogue to be ready for issue early in March.

The new binder twine factory at Brantford has acquired the buildings and lands of the old Cordage Company in West Brantford, and orders have been placed for machinery. A 150-h.p. engine is to be installed, and the factory will open about March 1st. Capital, $100,000. Officers: President, D. G. Hanmer, Mt. Vernon; vice-pres., F. Chalcraft, of Brantford; sec.-treas., A. H. Elliott, Brantford.

The Lambton woolen mills, owned by the Canada Woolen Mills, Ltd., were totally destroyed by fire on January 19th, and will not be rebuilt at Lambton. A shoddy plant to take its place will be installed by this company at Hespeler.

No appointment has yet been made to the city engineership of Chatham, Ont.

Sydney, N.S., is borrowing $235,000. Of this sum $35,000 is for paying the balance due the owners of the site conveyed to the Dominion Iron and Steel Company; $75,000 for the extension of waterworks; $75,000 for constructing sewers; $27,500 for additional school accommodation; $12,500 for a fire station and equipping a fire department, and $10,000 for sidewalks.

The B. F. Sturtevant Co., of Boston, Mass., was recently in receipt of a letter from the Enterprise Foundry Co., of Sackville, N.B., which contained this interesting evidence of the endurance of one of their blowers: "We have had one of your No. 6 noiseless blowers in use for 28 years with entire satisfaction, but the blast wheel is now apparently worn out, and the left side piece is broken. If we had this left side piece, and the blast wheel as shown in your circular it would make the blower all right. Can you furnish this for the No. 6 blower, which you were selling in 1872? This blower is driven by two belts but we fear we have been driving it at too high a speed."

The Buffalo Forge Company has recently placed upon the market a novel folding forge, which by reason of its light weight and exceedingly small compass, when knocked down and packed within its case, renders it a valuable article for army and navy use. The outside dimensions of the case into which it packs are but 22½ x 27½ x 10 inches. The forge is designated as the Buffalo Army and Navy Forge, and is now in use in the Imperial Japanese navy. The same company recently received an order for 100 of these forges for use by the United States in the Philippines. Owing to the necessity of shipping these forges on a certain transport, only three days were given in which to fill the order, but the forges were completed and placed upon the transport in the specified time.

The township of Shipton and village of Danville, Que., have voted security for bonds of $30,000 to Angus & Whiteford for a paper mill to be built on the Nicolet river, two miles from Danville. There is a water power of 20 feet head; and the new mill, which will be started soon, will have one 88-inch fourdrinier machine, and a capacity of 15 tons a day. Near this, on the same river, is the new pulp mill recently mentioned, which is built by James Morrill, and now nearly ready for operation. It has four grinders, four wet machines, and will produce 20 tons per day.

On the night of January 23rd one of the worst fires ever known in Montreal occurred; it started in the clothing factory of M. Saxe & Sons, St. Peter street, and consumed 30 buildings, mostly wholesale houses, in addition to the magnificent Board of Trade Building, all in the heart of the city. The burned district covers nearly four acres. The total loss is estimated at about $2,500,000, with insurance of $2,000,000. Only a few days previous, Thos. May & Sons, wholesale millinery, had suffered a loss of $250,000; partly covered by insurance, and again two days after the great fire, the Montreal Cold Storage Co.'s premises were burnt with a loss of $300,000, covered by insurance. The result of all this is a rise in rates by the Fire Insurance Companies of 50 per cent. in the business section of Montreal, with 25 per cent. added on extra hazardous risks. The absence of the chief of the fire brigade through illness, the narrowness of the streets and the want of more up-to-date fire appliances (some of the engines had broken down at the previous fire on Thos. May's premises) accounted for the great destruction of property.

The Quebec Pulp and Paper Company is about to erect a mill at Indian Lorette, Que., on the St. Charles river. The initial step will be the erection of a ground wood pulp mill of a capacity of 30 tons daily, and after that a sulphite pulp mill of 75 or 100 tons daily, to be followed by a paper mill of 50 tons daily. The brokers for the company are R. Wilson-Smith, Meldrum & Co., Montreal. The capital is to be $350,-Smith, Meldrum & Co., Montreal. The capital is to be $350,000.

Electric Flashes.

E. A. Sleeman, Guelph, is applying for power to extend the Guelph Electric Railway to Hespeler.

The receipts of the Toronto Street Ry. Co. for the past year amounted to $484,697.44, an increase of $173,770.18 over the receipts of 1899.

G. B. Burland, president of the Lachine Rapids Hydraulic Co., has officially announced that his company will not join or amalgamate with the other Montreal electrical companies.

E. M. S. Duchesnay, for many years superintendent of the Pacific division of the C.P.R., has been appointed superintendent of the Cuba Railway, to succeed the late Frank P. Brothers.

The Niagara, St. Catharines & Toronto Ry. is asking power from parliament to amalgamate with any other connecting electric company, or to buy or lease such other company's lines.

The Toronto and Suburban Electric Ry. are seeking an amendment to their charter through A. H. Royce, of Toronto, to enable them to increase their capital stock, and extend their line to Hamilton.

The Halifax Tramway Co. proposes to replace their wharves with a pier 210 feet wide by 180 feet in length, to be finished by May 1, also to build a 5,000-ton coal pocket with an automatic tramway to the power house.

J. S. Lovell, William Bain, E. W. McNeill, Robert Gowans and Augustin Scheurer, Toronto, have been incorporated as the Frankford Electric Light Company, Ltd.; capital, $40,000; head office, Frankford, Ont.

Sarnia has an electric street car system, the first car being run over the road on January 17. The power is supplied by the Sarnia Gas & Electric Co., and the line may be extended to Pt. Edward and the beach in the spring.

The Lighting and Power Co., of Montreal, will be the new name of the Chambly Mnfg. Co., with a capital of $25,-600,000. It will absorb the Royal Electric, Montreal Gas Co., Chambly Mnfg. Co., and the Lachine Rapids Hydraulic Company.

Cleary & Sutherland, of Windsor, Ont., are applying for incorporation, as the Essex and Kent Radial Railway Co., to build an electric railway from Windsor to Chatham, Ont., with branches from Maidstone Cross to Wheatley, Cedar Springs, and Blenheim.

Application will be made to incorporate the Talbot Road and Lake Shore Electric Railway Co., with power to construct and operate a system of electric surface railways, beginning at Windsor, Ont., and continuing through Essex, Kingsville, Leamington, Blenheim and Chatham.

The Niagara Falls, Park & River Ry. is applying to the Ontario Legislature for an Act to enable it to sell, and the Buffalo Ry. Co. to purchase the assets of the company, and to amend it franchise by providing for a renewal for a period of 10 years. The secretary has called the annual meeting for February 5th.

The Canadian Electro Chemical Co. are getting their new works at Sault Ste. Marie into shape. W. A. Fleming & Co., 771 Craig Street, Montreal, are fitting up the work with fire hose, hose carts, branch pipes and shut-offs, etc., and with the "Camel" brand hair belting for which they are sole agents in Canada.

Yarmouth, N.S., council has decided to buy an electric light plant for street lighting.

Almonte council contemplates the purchase of the local company's electric lighting plant.

Parry Sound has carried a bylaw to provide $20,500 to purchase the electric light plant and improve the waterworks.

C. A. Nutting, of Waterloo, Que., is applying for a charter for the Brome Lake Electric Power Co.; capital, $50,000.

The Toronto Electric Light Co. will instal, in a few weeks, a 1,500-h.p. compound engine of the marine type into their No. 3 station.

The Levis Electric Railway Company are applying for a charter to build a line from Levis, Que., to points in the counties of Dorchester and Bellechasse.

The council of Westmount, Que., has been assured by F. L. Wanklyn, of the Montreal Street Railway, that the town will have an electric railway up Mount Royal this year.

Franklin A. Hough, Amherstburg, Ont., is applying for incorporation for the South Essex Electric Ry., and power to continue the railway from Leamington to Pt. Pelee.

The ratepayers of Ayr, Ont., have voted a bonus of $2,000 to instal an electric light plant, and bring the Port Dover-Berlin electric railway to that village. J. S. Clark, the promoter, intends to use water power.

The Electrical Construction Co., of London, is installing two direct connected elevators in the Masonic Temple, London, Ont. This company is moving this month into its fine new works on Dundas street, recently mentioned in these columns.

At the first annual meeting of the Central Ontario Power Co., recently held in Toronto, the following officers were elected: Hon. R. Harcourt, president; Eugene Coste, first vice-president; James Kendry, M.P., second vice-president; and managing director; J. Alex. Culverwell, electrical engineer, of Peterboro and Toronto. The head office of the company is at Peterboro, Ont.

The Leamington, Ont., Electric Light Co., after the shutting off of the natural gas used by them for fuel, gave notice that all contracts for electric light were cancelled until they could get a supply of fuel. A new company is being promoted to look after the Leamington business, of which Mr. Easton, formerly with the Stevens Mnfg. Co., London, is one of the chief promoters.

Application has been made to the Ontario Legislature for power to revive the charter of the Chatham & Suburban Electric Ry., which contemplates running between Chatham, Blenheim & Rondeau on the south; Chatham, Mitchell's Bay, Wallaceburg, Dresden, and Petrolia on the north, and Tilbury on the west. This road is intended as a link in the system of radial railways contemplated in this section of Ontario, and not as a rival of the Chatham and Windsor Electric Ry., now seeking a charter.

The Douglas Avenue extension of the St. John, N.B., electric street railway has been dropped by the company, owing to the demand of the city for $10,000 towards the road improvement expenses, to which the company objected; but the Royal Kennebecasis Yacht Club is making a great effort to get the company to extend the line to Millidgeville. Electric extension to Rothesay and intermediate points is another dream of the future.

The Barton & Cornell Electric Motor Works, London, Ont., have recently filled the following orders: One 8-h.p. motor to Weldon & Co., St. Thomas, Ont.; one 3 h.p. motor to Sheppard Bros., St. Thomas, Ont.; one 15 h.p. motor to Queen City Plate Glass & Mirror Co., Toronto, Ont., one 300 light dynamo to McLagan Furniture Co.; Stratford, Ont.; one 150 light dynamo to Walkerton, Ont., Binder Twine Co.

The Niagara, St. Catharines and Toronto Electric Ry. has completed its survey for its western extension towards Hamilton, the company proposes a spur line from Beamsville to St. Anns and Smithville. At a special session of the Lincoln county council the franchise from St. Catharines to Beamsville was given to this company, thus shutting out the Hamilton, Grimsby and Beamsville Electric Railway.

The case of Wm. Harris vs. Toronto Electric Light Co. has been closed by the plaintiff withdrawing his appeal, and confessing liability for all costs.

Two electric furnaces have been installed in the Chemistry Department of McGill University. They are large enough to take off a current of 100 amperes, and a heat of 3,000 to 4,000 deg., centigrade, can be obtained in them.

According to the statement of a representative of the Canadian Niagara Falls Power Company, the work of preparing to transmit power from the Falls to Toronto will be actively begun during the coming summer, and power will be delivered in the city before July 1, 1903, the time limit fixed by the company's charter. The power may be brought across the lake by cable from Niagara or Port Dalhousie, or the company may bring it around the end of the lake over land, supplying the different towns with electric power.

The Electric Cab Company, of Toronto, has been incorporated, with a capital of $50,000, and the following officers: President, C. A. Ward, manager of the Arlington Hotel; vice-president, A. M. Thompson, of the Canadian Motor Company, Ltd., and secretary-treasurer, W. S. Jackson, of James Robertson & Co. The company will rent the Cyclorama building, near the Union Station, and will establish several electric cabs at regular rates, as well as two electric tally-ho's for the tourist trade.

A. B. Colvin, ex-treasurer of New York State; James Power, his partner, Æmilius Jarvis, J. W. Flavelle, and others, of Toronto, are arranging with the Westinghouse Electric Company for an electric line from Toronto to Buffalo. Mr. Colvin is the head of the Niagara Falls, St. Catharines and Toronto Electric Ry., which has now been extended from St. Catharines to Port Dalhousie, and has bought a line of steamers to run from Toronto to Port Dalhousie. It is proposed to carry passengers from Toronto to Buffalo during the Exhibition.

A company, entitled the Kettle River Power Co., has been incorporated in London, England, with a capital of £200,000, to acquire the rights of the Cascade Water Power and Light Company, Ltd., and to adopt an agreement with the London and British Gold Fields, Ltd. The last named company has for some time past been doing preliminary work to develop the water power of Kettle River at the falls, Cascade City, and it is the intention to supply power and light to towns, mines, etc., throughout the Boundary country.

At the annual meeting of the Ottawa Electric Railway Co., held a few days ago, O. T. Ahearn was elected president; P. Whelan, vice-president, and J. D. Fraser, secretary-treasurer. The passengers carried during the year numbered 7,940,656, an increase of over 2,000,000 over 1890. The company are introducing an electric sweeper built on new principles; it is double the power of the other sweepers, having two 50-h.p. motors; there are double rattan brushes at each end, which can be worked one end at a time; adjustable wings for clearing snow from the track are attached to the sides, and it is said to be a success.

There has recently been installed in Liverpool, Nova Scotia, an electric marine railway of a novel character. The electrical equipment was supplied by the Royal Electric Company, of Montreal, and was installed by the Maritime Electric Co., of Halifax, N. S. The equipment consists of a 30 h.p. induction motor, the motor shaft being geared to a heavy worm shaft and wheel; the worm wheel shaft carries a pinion wheel which gears into another large wheel, on the shaft of which is placed a large heavy sprocket wheel; over this sprocket wheel the heavy two inch chain meshes into heavy sprocket teeth. This chain hauls the vessel up on a cradle over a track projecting out into the River Mersey to a distance of 500 feet, on a grade of ½-inch to the foot. The track and cradle are built of heavy pine timbers. On Friday, January 11th, the first vessel was hauled up and lowered down again, all the apparatus and gear working well. It is interesting to note that Liverpool possessed the first marine railway in the Maritime Provinces, the motive power used being horses. It formerly took from 4 to 5 hours to haul up a vessel, whereas the same work is now performed in 20 minutes. The present railway is the first one in America, and probably the first one of its kind in the world operated electrically.

The village of Blenheim has voted in favor of a municipal lighting plant.

Eugene Mony, civil engineer; Chas. Archer, advocate, and J. A. O. Laforest, former superintendent of the Montreal Water Department, are promoting a company to supply electric light to Montreal and suburbs. They expect to develop power at the Back River near Sault aux Recollet.

The electrical tower now being built at Buffalo for the Pan-American Exposition will be 391 feet high, and will be illuminated at night by thousands of lights. The plant of the Niagara Falls Power Co., which supplies the electrical energy to the Exhibition, is now putting out a total power, which if done by steam, at the average results obtained in central station practice (6 lbs. of coal per Kilowatt hour), would require 600,000 tons of coal per year.

Railway Matters.

The Victoria & Eastern Ry. will build a $600,000 steel bridge over the Fraser River at New Westminster, B.C.

The Lindsay, Bobcaygeon & Pontypool Ry. Co. has commenced building its line from Burketon, Ont., via Lindsay, 40 miles.

Allan H. Royce, of Toronto, is applying to the Ontario Legislature for an extension of time for building the Strathroy and Southern Counties Ry.

The C.P.R. Co. has decided to build a spur line from Carlstadt Station, 156 miles northwest of Ft. William, into the Attikokan iron district, north of Lake Superior.

Mackenzie, Mann & Co. are asking for tenders for building abutments and piers for a bridge crossing the Rainy River, between the State of Minnesota and Province of Ontario.

Application will be made to incorporate a railway company to construct a line of railway from the mouth of the Dumoine River, thence by the most feasible route to James Bay.

The C.P.R. has taken over that section of the Nelson and Fort Shepherd Ry., between Five Mile Point and Nelson, B.C., which they purchased some time ago to give them an entrance into Nelson.

Wm. Mackenzie stated in Winnipeg last month that the Canadian Northern Ry. would erect a new station in that city, and also build a steel bridge there over the Red River. The station will be near the postoffice.

Macdonell, Boland & Thompson, Toronto, are applying for an Act to incorporate the "Rapid Transit Co," to construct and operate a system of elevated and surface railways in Toronto and adjoining municipalities.

The Orford Mountain Ry. Co. will apply for power authorizing the company to construct and operate a railway from a Point between Lawrenceville and Eastman, Que., north of Orford Mountain, to Magog, Que.

The Dominion Bridge Co. has been awarded the contract for the iron superstructure of the new C.P.R. bridge over the Red River at Winnipeg, the amount of the contract being $60,000. The contract for the masonry substructure will be let to a Winnipeg firm.

The Nova Scotia Central Ry. Co. is applying for incorporation to build a railway from New Glasgow, N.S., to Country Harbor, on the southern shore of the province, with power to construct a branch line from the head of Country Harbor to some point at Chedabucto Bay, near the town of Guysboro, or any other branch lines, docks, wharves, etc.

An important improvement on the G.T.R. has been the raising of seven miles of track near Trenton. Some of the fillings were from fifteen to twenty-five feet. The cost of the work was about $235,000. A new station is to be built at Trenton this spring at a cost of $10,000. It is expected that the double track between Hamilton and the Falls will be done in time to accommodate the Pan-American Exposition business. The second track is ready for use between Hamilton and Jordan, a distance of twenty-six miles.

Honore Gervais, of Quebec, is applying to incorporate the St. Lawrence Southern Ry. Co., to build a line from Valleyfield to St. Hyacinthe, Que.

Hon. R. R. Dobell, and others of Quebec, are applying for incorporation to build a line from Quebec, or some point on the Quebec and Lake St. John Ry. to the mouth of the Nottaway river on James' Bay.

Archer and Perron, solicitors, Montreal, are applying for a charter to build a railway from Kippewa Lake to Lake Abbittibi and James' Bay, with power to operate steamers on the lakes and rivers. Its name is to be the Interprovincial and James' Bay Railway Co.

The Gaspe & Western Ry. Co. is applying for incorporation, to build a railway from Fraserville, Que., to a point at Gaspe Basin; also to purchase and operate the Baie des Chaleurs Ry., and the Atlantic & Lake Superior Ry.

At the annual meeting of the Carillon & Grenville Ry Co., G. W. Simpson was elected president; H. W. Shepherd, vice-president; and R. W. Shepherd, secretary-treasurer. Some of the stockholders suggested the advisability of changing the motive power from steam to electricity, using the old Carillon canal water for generating power.

Wendel P. Jones, of Woodstock, N.B., is applying for power to build a line from a point on the White Pass and Yukon Ry. across the Lewis branch of the Yukon river to Hootalinqua river, thence to the Big Salmon river, also to extend the line north to the Stewart river, and to build a branch in the Hootalinqua and Big Salmon valleys.

C. H. LaBillois, commissioner of Public Works, Fredericton, N.B., is asking for tenders for the following bridges: Taylor's mill dam bridge, Rothsay, King's county, masonry, substructure and approaches; Brookton bridge, Brookton road, Albert county, to be entirely rebuilt; Springfield bridge, Upper Queensbury, York county, to be entirely rebuilt; Bull Creek bridge, Salem, Albert county, to be rebuilt; Gealy bridge, Parish of Petersville, Queen's county, to be entirely rebuilt; Coal Branch stream bridge, near Coal Mines, Weldford, Kent county, a new bridge; Sullivan bridge, across Waweig river, Farish of St. David, Charlotte county, to be rebuilt; McGregor bridge, Parish of Dalhousie, Restigouche county, to be rebuilt; Finger Board bridge, Parish of Dalhousie, Restigouche county, to be rebuilt; Cottage bridge, Parish of Dalhousie, Restigouche county, to be rebuilt; South Branch Oronocto bridge, Parish of Blissville, Sunbury county, to be rebuilt; Dunbar bridge, Tay Creek Hopetown, York county, to be rebuilt; Rockwell bridge, Parish of Burton, Sunbury county, to be rebuilt; King's bridge, over Swan Creek, Parish of Burton, Sunbury county, to be rebuilt; Gilchrist bridge, Parish of Northfield, Sunbury county, to be rebuilt. All the tenders for these bridges must be accompanied by a certified bank cheque equal to 5 per cent. of the tender, and of names of two sureties. Sergeson bridge on the Central Railway of New Brunswick, is finished, and trains running over it.

Mining Matters.

The Colonial Copper Co. are installing air compressors at their copper mines near Advocate Harbor, N.S.

A smelting company, acting in conjunction with the statistician of the San Francisco mint, estimates the gold taken out of the Klondike district last year at $21,358,320, and that from Nome, U.S., $4,367,804.

In a recent report to Ottawa on Yukon affairs Commissioner Ogilvie thinks that the copper and other mines of White Horse will, in a few years, rival Dawson. Coal is being mined at several points in Yukon to take the place of wood fuel, now becoming scarce.

The Nelson Miner estimates the value of the ore shipped during the year 1900 from several districts named as follows: Slocan, $1,000,000; Trail Creek (Rossland), $1,750,000; East Kootenay, $1,150,000; Nelson, $1,000,000; Boundary, $1,000,000; Ainsworth, $50,000; Lardeau, $30,000; total, $6,000,000.

A vein of almost pure magnetic iron 75 to 80 acres in extent and 40 feet in thickness has been located about two miles and a half from the station of the Great Northern Ry., in the Shawinigan district of Quebec, and the ore yields 70 per cent. of pure metal. A deposit of plumbago has also been found in the same neighborhood.

The magnetic iron ore property near Five Islands, Colchester county, N.S., and a black copper property within a mile of the former property belonging to Hugh Gillespie and Dr. Hayes, of Parrsboro, were sold by T. L. Salterio, of Halifax, to Hurd and Moore, of Rossland, B.C. The new owners intend to open up the property.

The Mining Department of McGill University has received the donation of a scholarship from the firm of Fraser & Chalmers, the mining engineers, of London and Chicago. To the student recommended each year by the faculty they will give an opportunity to work in their establishment for three months following his graduation, and will pay him enough to cover his expenses. The work will differ from year to year, consisting sometimes in the construction of mining machinery, sometimes in the erection of mining plant in the field.

It is reported from Sydney, N.S., that another coal company rivalling the Dominion Coal Company in magnitude of operations, is about being formed there. Senator David McKeen, vice-president of the Royal Bank of Canada, representing the Dominion Coal Co., director of the wealthy capitalists, has effected a consolidation of the coal interests near Sydney, known as the Moseley, McVey, White, Hickey and Keefe interests. These areas adjoin those of the Dominion Coal Company, and cover an extent of over ten miles, reaching from Cochrane Lake almost to Sydney Harbor. A large and expensive plant for experimental work has been secured.

The annual convention of the Federated Mining Institute of Canada will be held in Montreal on the 6th, 7th and 8th of March. The officers for 1901 are as follows:: President, Charles Fergie, Westville, N.S.; vice-president, R. R. Hedley, Nelson, B.C.; Graham Fraser, New Glasgow, N.S.; Dr. Frank D. Adami, Montreal; treasurer; B. Stevenson Brown, Montreal; secretary, B. T. A. Bell, Ottawa; council, John B. Hobson, Cariboo, B.C.; W. F. Little, Anthracite, N.W.T.; Prof. Dekalb, Kingston, Ont.; P. Kirkgaard, Deloro, Ont.; George R. Smith, Thetford Mines, Que.; J. T. McCall, Montreal; R. E. Chambers, Bell Island, Newfoundland; D. W. Robb, Amherst, N.S.

Two Chicago capitalists, Charles Neumann and Judge Kraus, have bought the Sultana nickel mine of J. B. Miller and H. W. Evenden, comprising 2,640 acres, 26 miles west of Sudbury, for $250,000. The Manitoulin & North Shore Railway, now under construction by the Clergue Company, is surveyed through the property, and it is expected that the road will be completed this year. The mine is said to contain the most marvellous deposit of nickel ore to be found anywhere in the world, and a report to the Globe states that within a year a nickel ore reducing plant and works to the amount of $100,000 will be erected within a year.

Another large compressor is being shipped by the Canadian Rand Drill Co. This is for the Rossland Great Western Mines (British American Corporation), and has compound or two stage air cylinders, 36 inches and 22 inches in diameter by 48 inches stroke. It is to be driven by an electric motor by means of a rope drive. The driving wheel on the compressor is 18 feet in diameter by 51 inches face, and is grooved for 22 ropes 1¼ inches in diameter. The wheel has a double set of arms, is made in halves and weighs complete about 40,000 pounds. The low pressure air cylinder has Corliss air valves driven by special valve gear. The inter cooler connecting the two air cylinders is of the company's most recent water tube type, which gave such good results on a compressor shipped to the same mine last summer. This makes the third 600-h.p. compressor shipped to the British American Corporation, the former two being direct connected to compound Corliss engines. The complete machine weighs about 150,000 lbs. Two more compressors will soon be shipped by the Rand Company to the Dominion Coal Company for their mines at Glace Bay, C.B., and one went forward about a month ago to the same company. Each of these compressors has two stage air cylinders 32 inches and 20 inches in diameter by 48

inches stroke with water-tube intercooler between them. The air cylinders are direct connected to compound Corliss engines, the cylinders being 20 inches and 36 inches in diameter by 48 inches stroke. Each machine has a capacity of about 3 000 cubic feet of free air per minute, and weighs about 150,-000 lbs.

Personal.

Harold H. Gibson, engineer and surveyor, Willowdale, has been appointed engineer for the township of Minto, Wellington Co., Ont.

F. W. Peters, of the C.P.R., has been promoted to be assistant general freight agent of the Pacific division, with headquarters at Vancouver, B.C.

H. E. Macdonell has been appointed acting assistant general freight agent of the C.P.R. for the Kootenay and Boundary districts, with headquarters at Nelson, B.C.

Richard Shopland, for the last ten years chief night engineer at the London, Ont., Electric Co., has accepted the position of chief engineer of the S.W. & A. street railway, Windsor.

Stuart Howard, who has won the Gzowski medal of the Canadian Society of Civil Engineers for the best paper of the year, has been appointed assistant city surveyor of Montreal.

N. M. McLeod, son of Prof. McLeod, of McGill University, has recently been appointed engineer in charge of the Canada Foundry Co.'s works, which are about to be largely extended.

F. H. Clergue, Sault Ste. Marie, Ont., will be given a banquet on February 15th, to celebrate his return from England. He will be presented with a gold watch and chain costing $500.

B. W. Folger, Jr., Kingston, Ont., has accepted the general superintendency of the elevated system of the Brooklyn Heights Ry. Co. Howard Folger will manage the Thousand Island Steamboat Co.

James Milne, who has been for some time past in Chicago superintending the American branch of the Jones Underfeed Stoker business, has returned to Toronto to take charge of the Canadian department. Mr. Milne's many Toronto friends will be glad to see him back.

P. W. St. George, who recently resigned the city surveyorship of Montreal, owing to the ever recurring interference of aldermen, is now manager of the Electric Fire-proofing Co., of that city, which is erecting a plant for fire-proofing wood by a special process.

It is reported that E. J. Russell has been appointed general manager of the Intercolonial Railway, succeeding D. Pottinger, who will retain his position of general manager of Government railways. Mr. Russell is a native of New Brunswick. He is now general superintendent of the Delaware, Lackawanna and Western.

Harold Fraser, son of the late Hon. C. F. Fraser, has been appointed manager of the electric light and gas plant at Brockville, recently acquired by the town. Mr. Fraser graduated as an electrical and civil engineer at McGill College, and was entered for a post graduate course when he enlisted in the first contingent for South Africa. Since returning from the war he has been in Plattsburg, getting practical instructions in gas making and electrical machinery.

As mentioned last month, R. S. Logan, lately private secretary to Chas. M. Hays, has been appointed assistant to the general manager of the Grand Trunk Railway system. After about six or seven years' experience in commercial life, Mr. Logan first entered the railroad service on October 1st, 1885, in the office of Mr. Hays, who was then secretary to A. A. Talmage, vice-president and general manager of the Wabash, as a clerk. In December, 1890, he was appointed as secretary to Mr. Hays, who had become general manager on the death of Mr. Talmage, in 1887. On his leaving the Wabash Mr. Logan remained in the same position for the first six months of 1896, when he again took service under Mr. Hays, as secretary at Montreal. As is the case with most of Mr. Hays proteges, Mr. Logan has won his promotion by his own assiduity and attention to work. Of Mr. Logan's work The Montreal Witness says: "He has acted as intermediary between the general manager and the public; has familiarized himself with the workings of the system; has been able to interpret the mind of the general manager in regard to large questions, and has been, under every circumstance, tactful, courteous and skilful to a degree, doing his work quietly but effectually, and sustaining confidential relations with perfect honor and credit to himself. His relations with all the officials are of a cordial character, and there will be general satisfaction felt that he remains in the service of the company."

MASONRY DAMS AND RETAINING WALLS IN GENERAL, CONCRETE WORKS, ETC.

BY CHARLES BAILLAIRGE, M.A., F.R.S.C., M.CAN. SOC. C. E.*

It must be admitted that "retaining walls" in Canada have had but a poor or short lived record; unless it be argued that their durability should, in the interests of the working classes, not be too persistent. But, as an engineer, the writer can not admit this. He has been associated with the reconstruction of many of these walls, and has witnessed the failure of so many others as to be entitled to say a word on the subject.

The City of Quebec is preeminently one of retaining walls; many of its streets on the inclined or hilly frontage of the town having had to be supported on the down side to level them up to necessary grade.

These walls have almost without exception been made unduly thin and altogether too much so to withstand the then pressures against them, or the stresses liable to obtain thereafter.

The Des Carrieres Street wall of some 600 feet in extent, in rear of Dufferin Terrace, erected about 60 years ago, under Government control, stood its own for only 30 years, and was rebuilt again under Government superintendence and at Government expense, it being then an enclosure wall of the so-called Governor's Garden of the period. This second edition of the structure again gave way to the earth pressure from in rear of it, and was rebuilt or erected a third time within the last few years under the writer's term of office as City Engineer, and at the cost of the city.

The retaining wall of the old parliament site at the head of Mountain Hill has during the same period of 60 years been rebuilt not less than twice.

The same fate has overtaken the Artillery Street wall; the Dambourges Street wall; and most of those along the north side of Cote d'Abrabam, and other streets, have had to be rebuilt during the writer's time, and generally after a persistence of only 10 to 20 years or less.

The splendid cut stone retaining wall along Commercial Street, Montreal, though built hardly 50 years ago, is and has been for some years back giving way, in like manner, from earth pressure in the rear; and the walls of the new Louise Docks at Quebec have already become disgracefully out of plumb and alignment from the same cause.

The impression, of course, has been in all these cases, or was at the time of construction, that the several walls mentioned, having nothing to withstand or bear up against but the pressure of so much dry earth behind them, they needed not to be of a thickness or breadth of base greater than from one-fifth to one-third their height, sometimes even less than this, and as low as one-seventh thereof, or about 3 ft. for a 20 ft. wall

The fact was overlooked that the dry earth backing might become waterlogged by infiltration, and especially so where no weepers had been provided for the removal of wet and moisture; or even with weepers, if the filling in their proximity was of too retentive or impermeable a nature, or where, in the case of weepers or no weepers, there had not been interposed between the back filling and the rear face of the wall a narrow space filled with loose material of a stony consistence to allow water, when reaching the wall, to run to the bottom thereof and thus find its way out or expend itself by absorption into the underlying soil

Yes, the writer has noticed in very many cases of such retaining walls and of those separating tenements on sloping ground, or lying back to back (the one at a higher, the other at a lower level) the ground embanked on the one or upper side to raise it to level of street on that side; excavated on the lower side; that the percolation into the embankment had absolutely waterlogged the filling and thus caused it to press with the pressure of a liquid or fluid on the inner face of wall, causing it to bulge or swell, and thus fail by disintegration, or to give way bodily.

* A paper read before the Canadian Society of Civil Engineers

Not that this waterlogging of the filling was of a permanent nature, nor need it be; but only of momentary duration, as it might produce a thrust forward of the wall, of only the fraction of an inch, thus enlarging its (the water's) containing space, and making room for itself to subside in, and gradually pass through the wall to the lower level, or evaporate or be absorbed by the subsoil. This waterlogging would, of course, be intermittent, and might recur again at every succeeding return of heavy rains, and the wall again be thrust forward, and each time by an additional fraction of an inch, and up to final destruction or overthrow of the stony structure

An unmistakable proof of this intermittent and instantaneous action of water, and of the fact of its thus acting during only a second or fraction of a second, is still to be seen along the rear face of Dufferin Terrace, Quebec, where, in an illustrated paper read before this Society in the early nineties, and published in its Transactions, it was shown by the writer that an open fissure in the cliff in rear of the terrace had, under a persistent and heavy rain of several days' duration, in September, 1880, become filled with water, when, due to the thrust from the rear, an outward portion of the cliff fell forward with the destruction of much property and the loss of some 52 lives. The crevasse alluded to, thus filled with water to a depth of over one hundred feet, exercising a hydrostatic pressure which pushed the intervening rock forward by some six inches.

Could this pressure have been continuous, the thrust of the cliff forward would also have followed suit, or been continuous, the aperture widening more and more till the whole cliff fell forward; but it was not continuous, nor could it be, for the moment the fissure became enlarged the water level fell, and the pressure ceasing, the motion forward stopped short at the same time

In addition to this action of a fluid or waterlogged substance against a retaining wall, there is also, in this climate, the yearly action of frost, which, in expanding the back filling, as water does in freezing, also pushes a wall forward or towards the open, and though but as ittle as the eighth or even the sixteenth part of an inch at a time, nishes in course of years by effecting its overthrow.

It is therefore seen that all retaining walls are a b e to become like unto dam walls, which have to stand the pressure of water, and that as such the same rules as to strength and thickness should apply.

Also that where ice may or might form in rear of a wall, and where this ice in forming can not spend its effort on compressible material towards the rear, as where such substance is solid rock or equivalent thereto, the whole effort is then against the wall, and, if repeated from year to year, the wall must go, as nothing can withstand or nullify the effect of ice expansion; since, as is well known, if an iron shell, a bomb, be filled with water, hermetically plugged, and then exposed to frost, the shell, however thick it may be, will burst. The only remedy, then, in such a case, the only safeguard for the retaining wall, is to so roof in or impermeably cover the surface of the back filling with asphalt or other watertight substance, that no water can get at it, or penetrate the soil in rear of the wall in a way to run the risk of any ice forming as said above.

It may also be remarked here that a Mr. Bone, engineer of the Oregonia Bridge Co., has recently patented and built at Columbus a concrete steel retaining wall, a section of which is to be seen at page 448 of the N. Y. Engineering Record for November 10, 1900. The thickness of this wall at base is less than one-sixth its height, and a simple a[illegible] of the figure will show, without resorting to any calculation of strains or resistances, that, unless the backfilling be self-supporting, such a wall can not continue for any length of time to stand the pressure of any ordinary back-filling against it without it tending to bend over or give way. The stiffening ribs of the iron or steel screen behind the wall are not nearly deep enough to act as efficient buttresses. They should for this purpose reach much further into the backing. The rod tieing the base of screen to the foundation can have no effect in preventing it from tilting forward. For this purpose the tie rod should have been attached to screen at say two-thirds of its height, and reached out far back to some unyielding pile or concrete anchorage

The subject of retaining walls would not be complete without an allusion to wooden walls instead of masonry for the same purposes. The author in his time has had occasion to build and rebuild at Quebec thousands of feet lineal of street supporting structures, *et al.*, of this kind, as well along the St. Lawrence and St Charles water frontages as along the side hills of the city. The respective lives of these walls may be taken at from 15 to 20 years average for spruce, and 25 to 30 years for pine timber while the portions under water, and even those extending to a few feet above low water, may endure indefinitely as far as material is concerned, but these walls, even though secured by cross ties running or tailing deep into the back filling, or to a depth, for the upper ones, fully equal to height of wall or wharf, give in course of time with the earth pressure and frost from behind, and thus gradually loose their batter (generally of 1 to 1½ in 12) by about a quarter or half an inch per annum, becoming vertical, and then begin to over-plumb, and about the time they are decayed to an extent to require repairing or rebuilding, the over-plumb reaches such a figure that they are ready to topple forward—that is, their fronts or timbered facings, which become torn away from the ties that head into them, as the outer ends of these ties or portions exposed to wind, water and weather also decay, thus allowing the front timbers to be thrust forward, whilst such portions of the ties as are buried in the back filling continue to endure and can outlive the outer timbers for years thereafter.

On the rebuilding of the facings, short ties may be thus used by spiking them to the remaining portions of the old ties, and when on a slope or side hill with tendency to slip forward, it is a good and even necessary precaution to bolt and, better still, to fox-bolt the ties to the adjoining or nearest rock, or attach them to piles or suitable pickets driven deeply into the subsoil: and this precaution is none the less pertinent in dealing with stone walls, which may thus be made to endure for a longer term of years.

Of course, if the back filling is of stone, more or less stratified and piled in a way not to have a tendency to thrust forward, or if the filling is of such a clayey nature that percolations from the surface may, instead of sinking into it, run off towards the open and find their way through or between the face timbers, the wall may then endure during its natural life as regards decay without losing its plumb or perpendicularity.

These facts are coming to be appreciated, and it is satisfactory to state here that with our engineers in general (we notice it most in the works of the C.P.R., the Grand Trunk, and others of the kind where retaining walls to excavated features of these roads are visible) extra thickness now prevails, and has done for some years past, and precautionary measures are resorted to to render all such work more permanent and resisting than heretofore.

The recent giving way of a coffer dam at the Boston Navy yard is also a case in point, where the filling-in was like unto a fluid substance, and required a thickness of wall equal to that of one having water to bear up against.

These failures are the best, the most instructive lessons to an engineer when the cause of failure can be got at or made known. Nothing is to be learned from a structure of any kind which holds its own, or persists, and does not give way, except that it is evidently strong enough, but it may also be too strong, ten times, a hundred times too strong, as of a column of a pillar or pier or wall which could bear ten times, a hundred times the weight it is called on to support. Now, the coffer dam alluded to was on sloping ground, with a consequently varying pressure of water against its sides, and the dam therefore made thicker, or the clay or puddle enclosing space between its walls wider at one point than at another, the dam being some six feet in breadth at its highest or shallowest portion, or inland, while increasing to not less than thirty-six feet at a salient angle where the depth of water rendered it pertinent to do so. The contractors were under the idea probably that the clay filling was or would be of such a nature as while watertight or impermeable, to stand its own, and be self-supporting, as would be the successive courses of masonry of a stone dam, each underlying course supporting the one above, and all those above it without crushing or giving way by spreading, like a plastic substance under a superincumbent weight. Under this idea of the non-giving nature of the clay, and of its self-supporting nature, the walls enclosing this dam were built of superimposed timbers of only eight inches square at bottom, and thinned out to 4 inch timbers at top, and to prevent the inbursting action of the water from without, these walls were braced with 8" x 8" timbers running horizontally across the dam from inner to outer wall thereof. The outer wall or towards the sea was moreover stayed or braced against giving outwardly, by sloped struts abutting against the bottom or ground of the foreshore, there being no danger of the structure giving on the inshore side, where the ground was high and sufficiently resisting to prevent any tendency of bursting outwards on that side.

The horizontal ties above alluded to (some 36 feet in length) do not even seem to have been supported as they should have been against sagging at the centre, as the engineer in charge tells us that the weight of clay as dumped into the dam enclosure caused these ties to sag and break; when, under the plastic and spreading nature of the filling, the outer wall for some 50 feet of its length was thrust forward and the clay filling ran out of it towards the sea.

This example is here introduced as proof of how the most compact filling material when dumped through water and becoming intermixed therewith may reduce to a semi-fluid substance, and exert the same pressure against its retaining walls as would so much water.

This coffer dam is now being reinforced, as it should have been from the first, by a structure of solid wooden crib work built outside of it, and of proper breadth of base with stone filling to prevent the spreading of the dam walls, and thus, as the writer holds, this failure of such a dam and in such a depth of water as 30 feet must prove to be a most instructive lesson to every engineer or contractor in going over the same ground.

Let us again here repeat the maxim that there can be nothing so instructive to the architectural or engineering profession as a failure of any kind when its why or wherefore can be arrived at, and the writer takes this opportunity of suggesting to the members of the respective professions, engineers, contractors and overseers, the advisability whenever it can be done, in the case of any accident to a dam or other structure of whatever nature, of immediately or before the debris is cleared away, enquiring into the cause or causes of such accident, and of reporting them for the information of professionals in the respective lines.

STONE OR MASONRY DAMS.

The author has for years past contended, and sees no reason as yet to be of a different opinion, that stone dams should at every point of their height be at least as thick as the height or depth of water above that point, including overflow, which means, in other words, that the weight of masonry of the whole dam or above a horizontal plane at any portion of its height—stone masonry being assumed as of twice the weight of water—should be twice that of the pressure or weight of water above such level. This, of course, refers to a dam built in horizontal course of masonry.

If the virtue or binding qualities of the cementing material could persist for all time, or for so many years as the dam was expected or called on to endure, this thickness of dam would not be advocated; but that it does not persist beyond an indefinite number of years is or was shown some few years ago by the failure of the Bouzey Dam in France, when some 232 lives were lost by the rush of water through the gap in the dam; and that it may not even persist for a single year, by the failure of the Austin Dam, so-called, or, in fact, that, as in that case, the cementing material between the courses was possessed of no adhesive quality whatever in the way of making a monolith of the whole structure

Then, if the cement can not be relied on to bind the structure into an indestructible whole, nothing remains to stand the pressure of the water tending to push the dam forward, but the weight of the structure and its co-efficient of friction of stone on stone or masonry on masonry. This co-efficient is known to be but .5, though given as .7 to start a stone from a state of repose, which it is evidently not prudent to rely on, as shown by the accidents alluded to at Bouzey, Austin and elsewhere. Portions of each of these dams were moved bodily forwards or down stream, without being either overthrown or disintegrated. An endeavor has been made to show that the toe of the Austin Dam was undermined, but this only corroborates the writer's views, as proved by the fact that when there was no more resistance at the toe to stand the thrust, the only remaining opposition to the dam moving forward was its adhesion to its foundation, and its weight. And yet, in spite of such presumable adhesion, and in spite of its frictional resistance, it was thrust completely forward, and to a considerable distance down stream.

What other conclusions, then, can be arrived at than that it was deficient in weight and therefore in thickness to such an extent as not even to develop an amount of friction capable of causing it to hold its own, or to resist the tendency of the water to push it forward, which it must have done had its weight under a co-efficient of 0.5 been at least twice that of the impounded water, or pressure due to weight or depth of water.

The conclusion to be arrived at is, therefore, inevitable, the author takes it, that for horizontally coursed masonry, where the cementing material has ceased to be binding, and where nothing is left to resist its being thrust forward but its co-efficient of friction 0.5, its weight should be twice that of the total pressure tending to move it forward, or, in other words, it should be (taking its weight as already set forth at twice the weight of the water, or say 125 pounds to the cubic foot) of a breadth of base at bottom level of reservoir or of impounded water equal to the height or depth not only of the water so impounded, but of the upper surface of the water when over-topping the dam—by whatever number of feet so over-topping it (11 to 12 feet in the case of the failure at Austin) or with an overflow of that number of feet above the crest of dam.

The theoretical section of dam would thus be that of a triangle, or in the case of no overflow the crest of dam would be a mere edge or arris, or of a width at top equal to the height of overflow, but in practice this upper edge is thickened out for practical considerations to at least 3 or 4 feet to allow of heavy and resisting coping stones, and as a pathway for foot passengers across the dam, while it may and generally is extended out to such a number of feet (8 to 10 feet) as will allow of a wheeled vehicle passing over it with room on one side to meet a foot passenger on the way, and thus extra thickness at top is brought about by gradually curving out and up the down face of the dam in a way to give the required width at top

A dam when intended to answer as a pathway or road from one bank of a river to the other, should, of course, be provided with a spill-way or freshet water, though in the case of the 12 ft. depth of overflow at the Austin, no reasonable size of spill-way could have been devised, no system of pipes and gates from the bottom which could have even commenced to deal with such an excess of water and as such an eventuality may happen in years, which may not have happened for a quarter or even half a century, as at Galveston, it is better to be on the safe side and in proportioning the dam allow for a possible overflow of such a number of feet as circumstances may render possible even if not probable; since the difference in cost can thereby be only slightly enhanced, which is absolutely as nothing beside the terrible disaster of loss of life and of having to expend hundreds of thousands of dollars to rebuild a dam, and during an interval of months or even years leaving a whole town or village or a city in total darkness and without power to drive its electric cars, or to work any of its public or private machinery or industries.

The foundation of a dam should, of course, be dug down to a solid and impermeable substratum, and this, stepped up and down to allow of the masonry or concrete interlocking in a way that there may never arise the eventuality of such a structure sliding forwards on its base or bottom.

What precedes, as already stated, relates only to horizontally coursed masonry dams, and where material is at hand to give the dam its required weight and thickness; but when material is scarce or expensive, the want or deficiency can be made up for or compensated in either of two ways, to wit, by throwing the courses up from a horizontal position on the up dam side to an inclined one on the down side, say by tilting up the beds or courses in a way to have them normal or perpendicular, or more or less so, to the outer slope or apron of the dam. By this system a much lesser thickness of dam wall can be made to answer; the tendency of the dam to go forward being in such case resisted not only by the force or weight necessary to overcome the friction of stone on stone, or of masonry on masonry, but, in addition to that, the force required in pushing the structure forward to raise it along an inclined plane and under favorable circumstances; a dam thus constructed might possibly be made of only half or two-thirds the thickness advocated for horizontally coursed masonry.

The other mode of constructing to avoid thickness, is or would be that of the Eddystone Lighthouse, in the British Channel between France and England, that is, by dovetailing and interlocking all the component stones of the structure, and that, of course, not only horizontally, but also vertically, and the lower foundation courses thus also vertically into recesses cut purposely in the solid rock, or again, may be, by fox-bolting every course, the one to the other, and the whole to the rock foundation.

This salient feature in the erection of masonry dams is, the author is glad to notice, coming to be recognized, and his advocacy of breadth of base equal to height is taking hold of the engineering mind, as at Massachusets, Jersey City, Denver, etc. Why! the very dam of our Quebec Impounding Reservoir at Lorette or St. Ambroise, and stretching for 200 feet in length across the river St. Charles, was built by Mr. G. Baldwin, of Boston, a very safe and cautious engineer, and moreover 50 years ago, of a thickness not only equal to the heighth or depth of water impounded, but, and as if by intuition, to such a further thickness or breadth of base as to allow for an overflow of some 3 feet, and on more than one occasion since 1851, when the dam was put in, the overflow has quite or nearly reached this figure, though ordinary spring freshets cause the water to overtop the crest of dam by only two feet, or less, and even this does not happen every year, the normal overflow varying from an inch or two to eight or ten.

CONCRETE DAMS.

The profession has now taken to the building of dams of concrete instead of masonry We now have in the Province of Quebec at least some five dams so constructed: one at Chambly one at Lachine, one across the Jacques Cartier River, one across the Montmorency, and one just completed across the Chaudiere a few miles west of Quebec, by Mr Stearns, a nephew of the gentleman of like name whom the Society had the pleasure of listening to on the occasion of our trip to Boston at the end of January and beginning of February of the present year, the last of the nineteenth century, on his grand scheme now under way for the Metropolitan W.W, whence some twenty eight Massachusetts towns or boroughs within a radius of some 25 miles around Boston are to be supplied Mr Stearns, of the Chaudiere works, is a specialist at concrete structures, having built entirely of con-

crete an arched bridge of some 30 feet span, and other structures. This gentleman is of opinion that concrete dams, on account of their thus monolithic nature, are, and will prove to be stronger and more resisting than dams of stone masonry, and what is of greater importance, that they can be built for half the cost of dams of masonry, which would seem to be the case when it is considered that the dam across the Chaudiere river, which is 850 feet in length, 23 broad at base, 20 feet 3 inches high above bed of river, and thus as thick as it is high, costs but $200,000.00, with all the adjuncts of a spillway, an enclosure of double the height for the three penstocks to draw from, each of them over 8 feet in diameter, running out and down the face of cliff as at Niagara, in a way to give a head of 110 feet at the turbines, the cost of which, and of the power house and rock excavated tail race are all included in the above sum of less than a quarter of a million of dollars, while intended, as they are, to supply Levis, St. Romuald, and adjoining parishes with electric light and power plant to drive electric cars

It has just been said that the Chaudiere dam carries out the author's theory of breadth of base equal to height or depth of water impounded, and allowing for overflow, while at Lachine and Chambly, at Jacques Cartier and Montmorency, the breadth of base is fully equal to and even in excess of depth of water held back.

Referring again to the Massachusetts dam over the Nashut at Clinton, 35 miles from Boston, which is to impound 63,000 million gallons of water (the greatest reservoir in the world after that of Perigar in India, and only less in height than the great Crotan dam now under construction for the New York Water System) its length being about 1400 feet, and height at centre 200 feet; this dam, which at first sight appears of less thickness than that advocated by the writer, is in reality found to be of such equality, when allowing for its great thickness at top, and its height, 25 feet above level of water in dam; that is, it gives the requisite weight duly to resist any tendency to thrust it forward, and, moreover, two of its features are those already alluded to, it being specified by Mr. Stearns that courses of masonry shall rise toward the downward face of the dam by one in four (1 in 4), while the contract also requires that the making of horizontal beds of masonry shall be avoided, but that on the contrary the beds shall be stepped, and that in each underlying bed there shall be stones projecting in a way to become incorporated in the next course above."

The greatest precautions have been taken in this case to guard against failure on account of the numerous and populous communities below the dam, and the important manufacturing interests centering there—for instance, some 875 borings have been made to an average depth of 20 feet, aggregating 16,905 feet lin.—the rock has been drilled to reveal its nature or geological features, as well as its position, in 38 places, giving together a depth of 2,489 feet, one hole being as much as 286 feet deep

The contractors, a very prudential feature, are to stop short with the blasting before they reach the actual depth at which the masonry is to be started, and the remainder of the rock thence removed by barring and wedging, so as not to disturb the underlying beds or strata in a way which by causing them to become loose, might possibly be creative of leaks beneath the dam The prospecting has been more thorough here than ever before in works of like nature. This drilling led to some heretofore unexpected features in the strata, such as finding beds or pockets of gravel beneath the solid rock or granite

The same thing, however, was met with in the case of the dry dock at Levis, opposite Quebec City Under a stratum of hard pan was found a bed of sand of considerable thickness, and such that the entrance to the dam had to be carried in, and the dam thus shortened by some 65 ft., requiring an expenditure of $118,000 for a coffer dam all this and the curtailment due to not drilling down or boring some distance into the apparent rock bottom, which would have revealed the fact, and saved the large expenditure. This graving dock is now being lengthened from the rear end and, in fact, now a days harbors are being dug, as at New York at present, to a depth of 40 feet, in view of the ocean liners of the future drawing 37½ ft of water (the difference, of course, to allow for "swell" of ocean) while docks are being made 1,000 feet in length, preparatory to that length of vessel being obtained early during the forthcoming century, to commence on the first of January next (1901)

Another extensive dam now under construction, as mentioned in the New York Engineering Record of October 14th, page 340, is that for the Denver W. W. It is being built across the so called Goose Creek Gorge, its height of impounded water is to be some 200 feet This dam, it is true, is but 168 feet base, but the upper base or summit has a breadth of not less than 28 feet, increasing the base of the theoretical triangular section to 196 feet which is close upon the depth of water to be impounded while the additional height of dam, or up to 210 feet, more than makes up the difference in weight required to stand the thrust

A 3,400 feet dam is also being built some 70 feet high at Boonton for the Jersey City Water Works. In writing to a New York engineering paper on this subject of dams, the author says, and the same thing may be repeated here: "Is it not strange that, while we are so particular in recommending a factor of safety of from 3 to 5 in bridges and other structural iron work, etc., and of as much as from 5 to 10 in structures where disintegration is possible under heavy loads, and the effects of weather, wear and tear, we have been in the habit of constantly neglecting any factor of safety at all, so to say, in the erection of such structures as dams, where failure must and almost always does lead to dire loss of life and property."

Nor need it be said here that Mr. Stearns has no doubt adopted the far more prudent system of not only giving the dam its proper cross section of weight equal to more than double that of the water impounded, as here advocated, but that in requiring in addition to that, that the beds be tilted, and the courses made purposely non-continuous, but stepped into altars, while introducing stones vertically binding the courses the one to the other as an additional precaution against any portion of the dam having a tendency to slip forward over the courses below, he is doing nothing more than introducing for the first time, may be, a proper factor of surety, a prudential and really essential one.

(To be continued).

Roger Atkinson, superintendent of rolling stock on the C.P.R., has resigned to accept a prominent position on the I.C.R., and has been succeeded by E. A. Williams, formerly mechanical superintendent of the Soo line. Mr. Atkinson was for many years mechanical superintendent of the C.P.R., in Montreal, and about a year ago was given charge of the car, locomotive and repair shops of the company.

—In conformity with a statute passed by the senate the board of examiners for the degree of Civil Engineering of Toronto University has been constituted. W. T. Jennings, Toronto, ex-president of the Canadian Society of Civil Engineers, is examiner in civil engineering; R. A. Ross, in mechanical and electrical engineering, and Geo. R. Mickle, B.A., of the School of Practical Science, in mining engineering. Mr. Jennings is chairman of the board, whose first degrees conferred will form an event of special interest in technical educational circles.

—At the annual meeting of the Ontario Lumbermen's Association last month, the following statistical information was presented on the production of lumber: The total production of white pine lumber of mills in northwestern Ontario, embracing all mills on Georgian Bay, Northern Division of Grand Trunk Railway to Callender and C.P.R.; North Bay to Rat Portage, was 476,000,000 feet in 1900, against 351,000,000 feet in 1899; increase, 125,000,000. The decrease in production of mills in Saginaw Valley and Lake Huron shore of Michigan hitherto supplied by Canadian logs, 92,282,000 feet, leaving a net increase of 32,718,000 feet entering into the market formerly supplied by the Michigan mills. The decrease of United States mills in the northwest district of Michigan, Wisconsin and Minnesota, which competes in the same market for 1900, was 478,603,000.

SUCCESS IN THE ENGINEERING PROFESSION.*

BY M. J. BUTLER, C.E.

I am to-night forcibly reminded of an event which happened to myself some twenty-seven years ago. I vividly recall the feeling of trepidation with which I presented myself as a senior matriculant, how I struggled and wrote for four days, endeavoring to convey to Dr. Johnston how much or how little I knew of the mysteries of algebra, trigonometry and the various subjects exacted at that time from aspiring, would be engineers. The fifth day found me in bed with a well-developed case of bronchitis, the consequence of which deprived me of the honor and advantage of having my name enrolled among the alumni of McGill University.

The subject matter I have selected for this evening is, "The Essential Qualifications for a Successful Career in the Engineering Profession." It is with considerable diffidence I

*A paper read before the Applied Science Society of McGill University session 1899-1900.

venture to submit to you my views on a matter of such importance, as to the measure of what constitute the essential qualifications for a successful career in engineering. To one person success is only measured by its money value, to another, by the purely technical achievements, to another the dignity and importance of the position attained, to another the special solution of intricate and abstruse problems of an abstract nature. Yet each in his way is a successful man, provided he accomplish the goal he set out to reach.

When I realize how well and how much might be said in support of the various phases of even one condition of successes, and the breadth and extent that an adequate treatment calls for, it will not, I am sure, surprise you to learn that to-night I am experiencing that sense of trepidations which nearly always comes over those who feel their lack of capacity to fully deal with the problem in hand. You will, therefore, I trust, extend to my efforts your kind forebearance, and for my shortcomings charitably consider the good-will for the deed. It is a maxim in science that for a clear understanding of the subject matter it is best to begin by defining terms; we must have our postulates, our axioms and definitions from which propositions may be proven. Hence, we will seek to define what we mean by a civil engineer. The most comprehensive and complete definition is that embodied in the charter of the Institution of Civil Engineers, viz.: "A society for the general advancement of mechanical science, and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a civil engineer, being the art of directing the great sources of power in nature for the use and convenience of man, as the means of production, and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbors, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purpose of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns."

It has also been, not inaptly, defined by the late A. M. Wellington, the well-known American engineer, as the doing for a dollar what almost anyone can do at some price.

It will be seen that engineering, in its broader sense, implies the practical application of science to the arts; it has to do with every walk in life, with every calling and every business, and from its very comprehensiveness, it follows, as a matter of course, that it is beyond the power of any one man, however gifted, to cover the whole field, hence comes specialization, the following out of one or two departments or sub-departments. For years past there has been a strong tendency in the technical schools to begin the separation at the outset of a professional education, hence we find electrical, mechanical, civil and mining engineering courses. I am not sure but that the tendency is to draw too narrow a line; the foundation for specialization must be laid, take care that it is not too shallow. You will find that every department of knowledge interlocks with some other department. Hence, let it be your aim to lay the foundation broad and deep, that it may worthily carry the superstructure it is hoped you will place upon it. "A man, who is so trained as to be blind to everything beyond his own department, is, indeed, weak—whether that department be a science, art, music, theology or commerce. A certain amount of versatility is essential to breadth of view; but it is not necessary that the student should be superficial. It is of the unmost importance that there shall be a thoroughness somewhere."

Let it be realized that engineering is a noble profession, that honesty and truth are its foundation stones. Nature's laws lie at the root of success, and failure on our part to know and apply them will be promptly punished. Every department of technical work is dependent upon and interlocks with so many others, that we must have a clear, general elementary knowledge of the usual course of studies embraced in the Applied Science Curriculum. Mineralogy and geology, chemistry, botany and sylva culture, biology, physics and mathematics, are conditions precedent to the successful study of the materials of engineering. The characteristic features and peculiarities of the various soils, gravels, clays and sands should be carefully studied. Even on a matter of such apparent simplicity as to what constitutes a good puddle clay, there is room for a difference of opinion. One set of engineers favor a pure fat clay, another demands a proportioned mixture of sand, gravel, and enough clay to give a mixture analogous to concrete, the clay performing the function of mortar, to cement and bind the coarse ingredients together. The truth is that either or both may be required, as different conditions demand different treatment. If the puddle can dry out, under any circumstances, the pure clay is wholly unsuitable. We should know the forest, the growth and conditions under which the several trees develop and their peculiarities. The timber may be properly studied in the laboratory, but the woods is the place to study the tree.

The young engineer usually begins his work as a draughtsman, therefore he should learn thoroughly all there is to learn of drawing. The college is the place to master principles. "The foundation for due preparation must be laid in student life, if ever, and he who lays it broad and deep may find himself called upon to take part in the struggles of the giants, which some day will be had."

The ability to make accurate and clear drawings, and to do neat lettering, is not as common as it should be, and yet it is on just such simple operations that experience is gained, and through which promotion comes. The civil engineering student learns the use of the measuring tape, the transit and level, as part of his regular course of instruction; in my opinion, it would be of the highest value to him to learn also the use of the steam and vacuum gauge, the indicator and dynamometer, which are supposed to peculiarly belong to the student of mechanical engineering. And in these days he needs must know something of electricity, and should, therefore, master the volt and ampere meter. So, in turn, the mechanical and electrical students should familiarize themselves with the instruments peculiar to the civil engineering student. Opportunities for employment are becoming rarer all the time, and the starter in life cannot be a chooser, he needs must take what he can get to do. If his training is broad enough, he will develop speedily, and later on will find it of assistance in his chosen specialty. It may happen that in the battle of life he will find his college specialty was one he was not adapted for, as it is by no means an uncommon experience to find the civil engineer spending his entire life in mechanical, electrical or mining pursuits.

You are fortunate, young men, in being privileged to study your profession in a university so magnificently equipped with learned instructors and mechanical appliances. You have the opportunity of seeing and studying the behavior of materials under stress, and of getting a thorough knowledge of that branch of your work in a way that books can never convey. Much of the knowledge acquired from books is abstract, and is in the nature of a study about the things, rather than a study of them. We should know them for what they are.

The engineer is not a mere staker out of works, he should be, by his education and training, an executive officer. Quite too often absorbed in the niceties of field practice and purely technical work, the engineer loses sight of the more important problems of doing the work. The administration work is cast upon the contractor, while the engineer sinks to the mere delineation of lines, either on paper or on the ground. Splitting hairs, leaving the log alongside, alone and unobserved. I take it the engineer should be not only capable of designing the work that he has in hand, but that he should also be capable of directing the manner of its doing. Of course, such direction calls for experience and business knowledge.

Engineering is a profession that demands large experience and common sense, the latter is an endowment of nature, the former must be had by doing the things to be done, beginning at the bottom and working slowly but surely up the ladder. A young graduate in engineering is in a position, if he has diligently availed himself of his opportunities, to rapidly acquire the practical side of his profession, but until he has had the benefit of experience, he is not fit to undertake the carrying on of works and, if he is wise, will not assume such responsibility. It is a common expression to remark that the young graduate has the theory of his profession, but not the practice, that there is a fine contempt for mere theorists in the public mind is beyond doubt. The question is what is really meant by a theoretical, as distinguished from a practical knowledge. Are they really antagonistic or supplementary.

The words are derived from the Greek, and if we accept the dictionary meanings, undoubtedly there is a difference, but taking things as they now are, I very much question the fact. I take it that the college work is abstract and fundamental, teaching elementary principles, the practical application of which supplements and rounds out the full all-around engineer. The so-called practical man is very often a mere copyist, who can reproduce only what he has a precedent for, and the blunders frequently made by such a man are as amusing as they are ridiculous. I heard a case where an architect undertook to design a low pressure steam-heating plant for a rather large building. He started from the boiler with a five-inch steam pipe, and radiated in the usual way throughout the buildings. All the pipes were so laid that the drips, containing the condensed steam, should be led by a return pipe to the boiler. Using a table for proportioning the carrying capacity of pipe, and adding up his drips, he specified a ten-inch return pipe to carry the water to the boiler!

Another case that has come under my notice. A large factory, on a river bank, using a non-condensing engine, found that the vapor was a good deal of a nuisance, as it escaped close to the office windows. The practical engineer was called in, and asked to remedy it; his idea was to carry a long pipe to a point where the vapor could escape—apparently not having ever heard of a condenser. On the other hand, there are numerous cases where a lack of practical experience has led to equally absurd results. The world rates most persons and things at about their true value, and the young man must realize that he has to wait for his turn, on the whole merit is recognized, and good, honest work gets its price. There are, no doubt, exceptions, but, on the whole, I think it may be taken as a safe statement, that the laborer is worthy of his hire and gets it.

To the young man, with life before him, the wise words of Bacon are surely appropriate: "I hold every man a debtor to his profession, from the which, as men, of course, do seek to receive countenance and profit. So ought they of duty to endeavor themselves, by way of amends, to be a help and ornament thereunto." How shall the debt be paid? I think the answer is simple to give, but possibly hard to pursue. Work, and hard, honest work is the price we must pay for success. A nation cannot rise to a greater height than that occupied by its citizens; so with a profession. If the individuals who constitute it are men of capacity, earnest of purpose, honest and sincere, the profession, as a whole, will take a high place in the esteem of their fellow-men. We should always anticipate opportunities by being ready for something a little better than we now have. It was long ago said: "That opportunity has hair in front, behind she is bald, if you seize her by the forelock, you may hold her, but if suffered to escape, not Jupiter himself can catch her again."

A successful engineer is a good business man; business habits merely mean that he is exact, regular and systematic in all he does. Inasmuch as all engineers are placed in a judicial or quasi judicial position at some time or other in their careers, it would seem that a knowledge of law should form a part of an engineer's training. I do not mean that he should undertake the functions of legal adviser to his company, but that he should learn the rules of evidence, and the principles of the law of contract. At times he will be a witness, possibly an expert witness. He should learn to distinguish between facts and conclusions—facts only are evidence. He should learn the basis on which opinion evidence is allowed. So with contracts, the rules respecting the formation of a contract. Who are competent parties; what constitutes a sufficient consideration; that the subject matter is one cognizable in the courts of the country, what agreement means, etc., etc.

It would seem needful that the engineer should be able to read a contract according to its legal intent. Under any circumstances, he is usually entrusted with the ministerial duty of carrying out its terms, and if, through lack of knowledge, he imports into it a meaning not contemplated, or loses the benefit of some carefully written clause, which may release a surety or by waiver of some right which he should exact, or by a line of conduct place a different meaning to that intended, he would find himself in a humiliating position. Courts are prone to accept the meaning placed upon a contract by the parties to it. So, too, with reward to corporations. In these modern days, nearly all great works are under the control of corporations. Now a corporation is a pure, legal entity, and exists only in contemplation of law. It is said to be "invisible, intangible, and existing only in the contemplation of law." Although it consists of persons, the persons do not constitute the corporation; its charter is its existence, the joint acts of all its members is not the act of the corporation, it can only act through its agents, the evidence of its acts should be witnessed by the affixing of its seal. It is true the tendency of modern courts is to recognize a broader sense of responsibility and liability for acts done by its agents, yet it is well to remember that a corporation acts through its corporate seal.

I will now venture to avail myself of the opportunity to do something I think is hardly fair, but will not carry the matter too far; namely to offer some advice as to certain things. Learn to be systematic, file all your papers, letters, reports and catalogues, under suitable headings; the habit is easily acquired while young, but difficult later on in life, and unless you have experienced it, no one would credit the loss of valuable time involved in searching for some lost document in any large office, when such a systematic method is not in vogue. Systematize your work. Be accurate in all your work, strike the words "near enough" out of your vocabulary; they do not belong to an engineer's work. Familiarize yourself with trade catalogues, they are quite often valuable text books. Keep a note book, and fill it with sketches and observations of accomplished works, pay particular attention to proportion of parts, consult older experienced engineers, you will find them willing to freely give advice, if nothing else; learn to distinguish between good and bad. Cultivate habits of observation, and seek to train the eye to a due sense of proportion. Know that a properly designed work always looks right to the trained eye.

Carlyle has well said: "The eye seeth only what the eye bringeth the means of seeing, to Newton and to Newton's dog diamond. What a pair of universes, and yet the painting upon the optical retina of both was probably the same."

Cultivate the habit of systematic reading, make it your pleasure. Read with care the engineering journals, and the transactions and proceedings of the great engineering societies. Do not try to memorize all you read, seek rather to remember the fact of having read; in other words, convert your mind into a digest and index, and you will make more progress.

"How index learning turns no student pale,
Yet holds the eel of science by the tail."

says Pope, in the Dunciad. Once again let me impress upon you the necessity for and the advantage of being ready, and in conclusion, I shall quote to you some lines on "Opportunity," written by John J. Ingalls:

Master of human destinies am I!
Fame, love and fortune on my footsteps wait,
Cities and fields I walk; I penetrate
Deserts and seas remote, and passing by
Hovel, and mart, and palace—soon or late—
I knock unbidden once at every gate!
If sleeping wake—if feasting, rise before,
I turn away. It is the hour of fate;
And they who follow me reach every state
Mortals desire, and conquer every foe
Save death; but those who doubt or hesitate,
Condemned to failure, penury and woe,
Seek me in vain, and uselessly implore.
I answer not, and I return— no more!
—John J. Ingalls.

I thank you for the honor you have done me in inviting me to address you.

James Burrill, B. B. Law, and George Bingay, Yarmouth, N.S., are applying for incorporation to build an electric railway from Yarmouth to Maitland, to be known as the Bay Shore Railway Co., Ltd. Capital, $250,000.

A COMPETENT BOOK-KEEPER wishes situation as accountant, or for general electrical work. Address, **R.H.**, c/o Canadian Engineer.

WANTED A Mechanical Draughtsman. One accustomed to general machine design preferred. Address D. B., care of Canadian Engineer, Montreal, P. Q

The Canadian Engineer

VOL. VIII.—No. 11. TORONTO AND MONTREAL, MARCH, 1901. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

SEE PAGE 234 FOR CONTENTS.

INDUSTRIAL PRIMACY OF THE TWENTIETH CENTURY.

There is much talk at the present time, both in the English and United States press, of the rise of America as a commercial and manufacturing power, and there are many prophets, who see through the rosy-colored glass of hope, the predominance of the United States among the manufacturing nations of the 20th century. Britain is to be relegated to the second place, perhaps to the third place, in which case Germany would rank next to the United States. It is true that it takes an earthquake to arouse the British people from the lethargy that seems to overtake the nation at given periods, but there are a number of contingencies to be taken into account before the question of manufacturing primacy can be settled. At the middle of the 19th century, Great Britain was the body and bones of the British Empire. At the dawn of this century these islands are still the heart of the Empire, but the body has grown until its limbs grasp the four continents and compass the seven seas. The Commonwealth of Australia, the incipient federation of the United States of South Africa, the Empire of India, and the great Dominion of Canada, are now nations in themselves, and they are the strong limbs and organs of the new body of the British Empire created since the beginning of the Victorian age.

As to this question of manufacturing supremacy, Canada will have something to do as well as something to say. We have here half the continent of America, not only in geographical area, but in potential resources. It is true that a large portion of these resources are as yet undeveloped, and many of them really unknown, but in these days of remarkable engineering developments, and the facilities of construction rendered possible by modern machinery, these resources will soon be turned into account. We have already referred to the great development being made in the exploitation of some of these resources by such men as H. M. Whitney, F. H. Clergue, and others, and these isolated efforts are only the beginning of industrial movements which will place Canada in no mean position alongside of the United States.

Look for a moment at the facilities Canada possesses in shipbuilding. In Nova Scotia and Cape Breton we have a province situated geographically better than any of the sea coast divisions of the United States, to compete with the trade between the Western Hemisphere and Europe, while as for the industry of shipbuilding itself, its position is unique. No other country in the world, not even excepting Great Britain itself, has such a combination of limitless stores of coal, iron, limestone, timber, and other raw materials for shipbuilding, all placed together by nature within the easiest access to the sea, and what is more to the purpose, no other country has such a remarkable coast line as this province, where all inhabitants may become familiar with the great element whose control forms the key of future power. There is not a single county in the whole of Nova Scotia and Cape Breton which has not the sea for one or more of its boundaries, while New Brunswick is scarcely less favorably situated today for the up-building of maritime strength. After the middle of the last century, before wooden ship-building had declined, Canada was the third power in the world in its tonnage of commercial shipping, but in the interval between the age of wooden ships and that of iron and steel vessels, we have simply failed to realize the strength that is in us. Now, however, we have begun to wake up, and it will be but a few years before the Canadian Maritime Provinces will be building steel ships to greater advantage than any country in Europe or America, while on the Pacific coast the situation of British Columbia and Vancouver Island are equally marked out by nature for the same prominence when compared to American Pacific States, which our Maritime Provinces hold over the Atlantic States, only the development of this industry on the Pacific may be deferred for a number of years. The development of the inland resources of Canada, which will be brought about by railway construction and improved navigation of our lakes and rivers, is just as certain as that of our two sea coasts, while to north, towards Hudson Bay, "the first low wash" of that tide of industrial activity is beginning and will roll on to an extent which can not yet be estimated. Apart from the resources of Canada in minerals and in forest and agricultural wealth, the colossal chain of water-powers are a source of industrial strength to which no land in the world can show a parallel. These powers are every year becoming better appreciated as an element of strength in the industry of this century, and the progress of electricity will raise the value of this great source of power still more in the near future. Taking these various ele-

ments of industrial power into consideration, and recognizing the fact that Canada is heart and soul a part of the British Empire, it is rash to predict that the United States is destined to eclipse Great Britain in the "strenuous years to be."

British capitalists, however, must realize more clearly than they seem now to do, that the devlopment of the latent resources of Canada under the new conditions of engineering science, is their surest hope for maintaining the industrial position of the Empire, and more particularly its supremacy as a shipbuilding Empire. If the millions of capital that is now being thrown into Russia and other foreign countries were invested in the iron, steel, nickel, and other industries of Canada, the dangers that threaten this Empire from the rivalry of the United States and Germany would soon be averted.

THE CHEMISTRY OF PAPER MAKING

BY JOHN WADDELL, B.A., D.SC., PH.D., LECTURER ON INDUSTRIAL CHEMISTRY IN THE SCHOOL OF MINING, KINGSTON.

The manufacture of paper is largely a mechanical process. The foundation material is cellulose which is derived from various sources and is provided by nature in a state of greater or less purity. Cotton fibre is almost pure cellulose though slightly modified on the outside and having a protecting film of wax and oily matter. The fibres consist of a single cell, for the most part between one and two inches in length and about 1-2000 inch in diameter. Linen fibre is not so pure cellulose as cotton but is stronger and has greater lustre.

In cotton and linen thread the fibres are twisted together in the direction of their length, and cloth is woven from threads which run in two directions. But in paper, the fibres should lie in all directions forming a felt, the length of fibre not being so important a matter as in thread and cloth. Hence when paper is manufactured from rags these must be torn and divided in such a way as to isolate the individual fibres. The mechanical treatment is however not usually sufficient. Rags are often dirty and must be cleaned. This is done to a certain extent by beating, but afterwards the rags are boiled for several hours with soda or lime. This treatment, moreover, removes size and attacks colouring matter which is thus more easily bleached. The amount of caustic soda is from five to ten per cent. of the weight of the rags, the pressure under which the boiling takes place is two or three atmospheres. Too great pressure would fix the dirt in the rags instead of removing it. For delicate fibres some manufacturers prefer lime, as being less injurious to the fibres, but a larger proportion of lime than is actually necessary to reduce the stock must be used and the excess must be washed out. Furthermore, lime is liable to contain small gritty particles which are apt to become fixed in the fibres.

Since the length of fibre is not so important in paper as in cloth, cellulose which is not suitable for the latter may be employed in the former, and though cotton and linen rags furnish the best paper other raw material is largely used. Before the year 1837 there was in Britain an excise duty on paper of 3d. a pound, and the demand for paper could be easily supplied by the use of rags. In that year the duty was reduced to 1½d., and the demand increased. When in 1861 the duty was abolished altogether, the demand for paper became still greater and other raw materials came into requisition, for example straw, esparto or Spanish grass, and, most important in this country, wood pulp.

A very coarse paper may be made by simply grinding wood to a pulp, but the cellulose is mixed with intercellular tissue such as lignin and resinous matters which turn brown on exposure to light. "Mechanical pulp" is not suitable for the finer qualities of paper for which "chemical pulp" may be used. Chemical pulp is usually made by the action of soda or calcium bisulphite upon wood which has first been cut into boards, and, after being freed from knots, is broken or cut into small chips.

It may readily be imagined that many other chemicals have been used for the purpose. In most cases the action has consisted in hydrolysis or an addition of water, more or less aided by secondary reactions. In 1866 a process involving the use of water alone at a temperature of 150°C (302° Fahr.) was made use of. A brown pulp is obtained containing 70% of the original wood but there is an accumulation of matters of an aldehydic nature and there is, to a certain extent, a reversal of the reaction under which the wood becomes dehydrated by the high temperature. The addition of hydrochloric acid was tried for some time in Switzerland, and coarse packing paper was made, but the process was open to the same objection as with water alone. In 1852, the action of nitric acid was tried, also in 1862. Here the hydrolysis was aided by the oxidising action of the acid and a yield of pulp of 40% was obtained. But it is difficult to get large vessels to withstand the action of the acids and nitric acid is liable to yield explosion compounds.

Caustic soda was first used in 1853 and for some years continued to be the most suitable reagent discovered. There have been many patents and many slight variations in detail but the process practically consists in boiling the wood at a temperature 150° to 180°C (302° to 356° Fahr.) the pressure being about 90 pounds. The solution contains 10% to 20% caustic soda and the boiling is continued from eight to twelve hours. In some cases there is an alternation of treatment with soda and with chlorine, the soda in the later treatments being dilute. In the treatment with soda, the oxidation goes farther than with water or hydrochloric acid; for, instead of aldehydes, acids are produced and these uniting with soda form salts. The action is complicated as is shown by the number of bi-products.

In 1866 Tilghmann made use, though not very successfully, of sulphurous acid as a digester of wood, but obtained better results with acid sulphites. In 1882, Pictet also made use of sulphurous acid and apparently with some success. The sulphurous acid is largely recovered by being allowed to blow off from the digester into cold water where it is absorbed. As the sulphurous acid is little changed in the digester, its better action than that of hydrochloric acid is probably to be attributed to unstable compounds being formed under pressure and decomposed when the pressure is removed. About 40% of the wood is changed into a soluble modification and the brownish pulp which is left gives on bleaching a pure cellulose.

The use of acid sulphites has an advantage over sulphurous acid alone. Calcium bisulphite is the most common reagent because usually the cheapest, but the presence of magnesia is no disadvantage, hence magnesian limestone may be used in the preparation of the bisulphite. Limestone in a tower is subjected to the combined action of water and of sulphur dioxide, the gas being introduced at the bottom of the tower and meeting a stream of water which trickles down over the limestone. The action of the bisulphites is very similar to that of the acid, but the organic aldehydes and acids produced, unite either with the

sulphite itself or with its basic part. Secondary reactions by which tarry products are formed, when the acid alone is used, are not produced when the bisulphite is employed, probably because of the firm compounds formed by the union of bisulphite with aldehydes. The pulp has a brownish to creamy shade, not being so dark as when sulphurous acid is used. A larger amount of bleach is however required than one might expect from the light colour, 15% to 30% of bleaching powder being required. The bleaching causes little loss of cellulose, the amount of which obtained is nearly if not quite half of the quantity of the original wood. The formation of the aldehyde bisulphite compounds helps in the hydrolysis of the lignocellulose which is one of the chief constituents of wood requiring decomposition.

Since the soda and the bisulphite processes are the main competitors it is well to consider the relative advantages and disadvantages. The object aimed at is the loosening of the fibres from the encrusting material, including resin. Boiling with either soda or sulphite does this, but the resin is saponified by soda and is easily washed away. Though continued washing of the sulphite pulp with hot water, especially if containing hydrochloric acid, removes resin, the pulp darkens somewhat, and in some cases (doubtless where a special bleaching is omitted) a little bisulphite is added after the washing to improve the color. The improvement is, however, temporary, the paper is weakened, and soon becomes yellow. Digestion with soda gives a softer and more opaque pulp, but at the high temperature and great pressure necessary, partial dehydration of the wood takes place, causing something similar to charring, and so producing a brown color. The cellulose itself is also attacked, and thus the fibre is weakened. The yield of pulp is considerably less, being in the case of white pine approximately 33% of the original wood, while treatment with bi.sulphite gives 45% to 50%.

There is an economy in the soda process, in that the soda can be easily recovered, the solution being evaporated to dryness, and the residue roasted, thus forming carbonate. When heat for evaporation is easily obtainable the cost of recovery is small. The bi-products of the bisulphite treatment have so far found no industrial application, notwithstanding the fact that they contain non-cellulose materials in an almost unchanged condition. Which process may be most suitable sometimes depends upon local conditions; the sulphite process is to be employed in the large mills at Sault Ste. Marie. Sulphite prevents oxidation, which in the soda treatment diminishes the effect.

In the making of paper, boiled rags, grass, straw or wood, or a mixture of these materials, is thoroughly broken up into the small fibres in a "beating engine" or "hollander," in which also the bleaching is frequently carried out, though a separate vessel, the "potcher" is sometimes used. Bleaching powder is the most common re-agent, the addition of alum to which is an advantage, preserving the fibres, probably because of less violent action.

The electrolysis of magnesium chloride solution is also employed. The solution contains 5 per cent. or less of magnesium chloride. By its electrolysis hypochlorou acid is produced at the positive pole and bleaches the material. The bleaching is more rapid than with bleaching powder, causes less loss in the substance bleached for the degree of whiteness obtained and requires less available chlorine.

When the bleaching is completed the bleach must be washed out or neutralized by an "antichlor" of which sodium hyposulphite (thiosulphate) is the most common. Bleaching by chlorine in water or by hypochlorous acid, is practically a case of oxidation, and the antichlor is a reducing agent.

Cellulose is the main constituent of paper, but pure cellulose forms a felt that is too open, and would allow ink to spread. Hence some substance is added to fill up the interspaces, and to give the paper a firmer texture. This process is called loading. The loading material is often kaolin, but for the better qualities, calcium sulphate (pearl hardening) barium sulphate and agalite (a form of magnesium silicate) are used. The loading is from 3% to 20%, or in some cases even as much as 40%. The loading must be in a fine state of division, and must not be allowed to settle to the bottom. Special care must be taken with barium sulphate, awing to its great specific gravity. The loading is added in the beating engine, where also some colouring matter is frequently put in. Bleaching gives a slightly yellow tint to the stuff, and to counteract this shade ultra-marine is commonly employed. For making coloured papers, aniline dyes are largely employed, though mineral colouring matters are also used. Starch is added to pulp, so that in the later stages it may give the paper a hardness and glaze that would not otherwise be attainable.

Sometimes size is also added in the beating engine, though sometimes it is applied later to the paper when formed. The object of size is to fill the pores even more completely than is done by the loading, and a material is chosen which has the power of resisting the action of water to at least a certain extent.

When size is added in the beating engine the material used is resin soap obtained by the action of soda on resin. Alum is afterwards added. If the sizing process is postponed till the pulp is manufactured into paper, the material used is gelatine. But the chemistry of sizing is too complicated to be discussed at the end of an article. The pulp having been prepared it must be properly strained and supplied regularly to the frames of wire gauze, on which it is deposited, and on which the fibres are felted together, whence the paper is passed between press rolls, drying cylinders and calendar rolls, in order to compact, dry and polish the paper.

This part of the process involves, however, little of a chemical nature.

THE METRIC SYSTEM.

One would think by the off-hand manner in which the Canadian Manufacturers' Association have decided in favor of the metric system, that its introduction into Canada and the British Empire, generally, was as easy as rolling off a log. At the meeting at which this decision was so easily arrived at, not one of the speakers appears to have taken any account of the practical difficulties in the way of the change from the British standards to the metric system. The metric system would bring about a great saving of calculations for some classes of work, but it would immensely add to the calculations required in other classes, and the highest authorities of Great Britain and the United States appear to be pretty evenly divided as to the balance of these advantages and disadvantages for engineering work. For all work requiring binary or ternary calculations, that is for divisions of measures into halves or thirds and the corresponding multiplication of units, the change would mean a great loss, and so in

the measurement of areas. Many of these calculations can now be easily made mentally, whereas it is impossible to carry them on in decimals by mental arithmetic. Take the simple illustration of a brick in the building trade. A brick is ¾ x ¼ of a foot, and its breadth is its length divided binarily. These are convenient fractions, and from them quantities can easily be calculated. The thickness and length of brick walls contain so many courses of brick work, all in terms of the foot, but if the metric system be applied to this it will be found that a brick is equal to 0.2286 x 0.0762 x 0.1143 of a meter. Let a builder try to estimate the quantities for a house on this system. The bricks would have to be changed to suit the new system. Old bricks could not be used for the new standard, and all present brick machinery would become useless. And speaking of machinery, every screw, nut, bolt and other item of machinery, would have to be changed from our present standards and made to sizes to suit the metric system. The cost of such a change would be something enormous, for it would involve not only the discarding of all present standards in machine work, as well as stocks of pieces, but it would necessitate the entire change of the machinery by which they were manufactured. Then, again, it must be remembered that even its advocates do not contend that the metric system is an ideal one. The meter is supposed to be one-ten-millionth part of the quadrant of the meridian at Paris, but recent calculations prove that this is not correct. For practical purposes this does not matter, but in every day work it is a matter of consequence that the meter is not a convenient unit of measure. The English yard is more nearly the stride of an average man, and a foot is also a convenient measure of length The foot is already divided decimally in English measurements for many purposes, while for other purposes its present division into inches or twelfths is more convenient than fifths, tenths and hundredths. The foot is also a handy measure for hydraulic and other calculations, as it corresponds very well with the gallon and the pound. Twenty-five quarter gallons, or fifty pints making for practical purposes a cubic foot, and ten pounds of water make a gallon. Sir Frederick Bramwell, president of the Institution of Civil Engineers of Great Britain, in a discussion of this subject, brings out the following points, which show that the metric system has its drawbacks:

"Some years ago he went into the workshops of the Paris and Lyons Railway, where he was shown a drawing of a locomotive with a variable blast-pipe, and he asked what was the maximum and what the minimum area. One of the engineers took a sheet of foolscap and covered it with figures from top to bottom, and then gave him a dimension rather bigger than that of the cylinder. Sir Frederick had a two-foot rule in his pocket, and, finding that the drawing was made on the scale of one tenth, he applied the English inch-tenth, and so got out the area and translated it into French measures, which he did in one-fifth of the time occupied by the man figuring on the paper. He did not displace the decimal point because he had not got one. Reverting to the calculations on the wall (made by the author of a paper on the advantages of the metric system), he wished to show how utterly misleading they were. The author had placed before the members two comparative calculations, employed to ascertain the weight in tons and decimals of tons of water contained in a given-sized vessel. In consequence of the bulk of water representing the weight in French measures, he was enabled to stop in his calculations on arriving at the cubic contents, and to say: 'The whole thing is done; there is the weight of the water; but if you do it in English measurements, you will have all these additional figures to use before you can get the weight of the water.' Assume for the moment the difference in the length of the two calculations existed, what did it prove as regarded the general question? Nothing whatever. To what did it apply? To fresh water at a particular temperature, and to nothing else. There was no other liquid on the face of the earth, from ether to mercury, for which it would be true. It was not true for salt water, nor would it even do for fresh water at a different temperature. In any other case a multiplier must be used to get the weight, which would make the metric calculation as complex as the author's English example. But who, but one whose mind was warped by the metric system, would have thought of turning inches into decimals of feet prior to calculation? Would not anyone else have worked the sum thus? The annexed sum showed how anyone not saturated with the decimals dealing with 10 feet 6 inches by 6 feet 2 inches by 1 foot 1 inch, would have treated it. There in twenty-five figures was the answer as regarded the cubic contents, while the metric system, to reach the same point, needed thirty-five figures. Mr. Percy Fowler had spoken, to his great astonishment, of the way in which workmen in Spain used the metric system, and made calculations which persons of the same class could not make in England with the ordinary English measures. He had never traveled in Spain, but he had traveled in France, Italy and Germany, and had made it his business to ascertain what the facts were with regard to the powers of the people to do anything in the way of mental arithmetic, and he said unhesitatingly that in those three countries it was the rarest thing possible to meet a person who could make a mental calculation, not because they were wanting in intelligence or ability, for they were quite equal to the English in those respects, but because they dealt with a system so cumbrous that it absolutely precluded mental calculation. Let anyone go to a French railway station and ask for three tickets from A to B, and it would generally be found that the man (or, as was commonly the case, a woman, with a man to look after her), could not tell the amount without taking a piece of chalk or pencil and making a calculation. The clerk would have no more idea of what three times the single fare was than a child would have. Compare such a person's power of calculation with that of an English butcher's wife or daughter, who was in the habit of dealing with pounds and ounces and pence. Let him test the question nearer home. Could many of those present mentally square 3.25? He believed very few. But there was no difficulty in squaring $3\frac{1}{4}$ = 10 9-16; 10 9/16 was a sum easily appreciated and easily expressed, while in 10.5625 the decimal equivalent of the vulgar fraction was much more cumbrous, and he ventured to think did not form any impression on the

10	6	
6	2	
63	0	
1	9	
64	9	
1	1	
64	9	
5	4	9
70	1	9

mind, except that it was little more than half. Again, which of them could square 4.125? That, to the majority, would be almost impossible, but with 4⅛ there was no difficulty. 17 1-64 compared with 17.015625. It appeared to him that a system like the present one, which enabled mental calculations to be made rapidly and accurately, was enough for all practical purposes. It did not lie in the mouth of decimalists to insist upon absolute accuracy, because they were content with approximation, and must of necessity be so in many cases. With regard to the statement as to the meter being the ten-millionth part of a quadrant of the meridian, Mr. Hawkesley had fully exposed this in his presidential address, to which he would refer the members. The whole thing had been a failure, and the French themselves did not use the notation, nor did they use the unit of weight. It had been intended, if it were desired to express the thousandth part of a meter, it should be done by writing the word meter and putting below it a decimal point, followed by two o's and a 1, thus:

Meter.
0.001;

but what was the fact? A millimeter was expressed by m/m. So with kilogram. It was intended that should be the unit, and the lesser divisions were to be indicated by a decimal point, and the regular number of ciphers, but the fact was the unit was too large, and accordingly the French bought and sold by the half-kilogram, and they called it the ½ kilo, and not 0.500 kilo, or even 500 grams; these modes were too roundabout, as compared with 'half a kilogram,' and humanity would say half a kilogram in spite of all penalties. Centimes, again, were often replaced by sous. The 'tonne,' also, was not a part of the metric system, but was an invention to cure a failure in the system. People did not and would not deal with thousands of figures, when they could adopt another mode of expressing the number compendiously by a single figure. As regards the facilities afforded by English weights and measures, he desired to be permitted to refer to the numberless short cuts in mental calculations given by the present system. How much they would have to forego if they were forbidden to say that plate-iron was five pounds to the foot super, and cast-iron 4 inches to the pound, adding 1-20th to make the necessary correction. Round-iron, by the present system, could have its weight calculated in a moment, squaring the diameter in eighths, and dividing by twenty-five, or multiplying by four, gave the weight in pounds per foot at once; for example, $1\frac{3}{8} = 11$; $11^2 = 121$; $121 \times 4 = 484$ lbs., per foot. Water has been referred to as an instance of the wonderful use of the metric system. He would take a water illustration of a simple calculation by the English system. If engineers wanted to know how much a pump would lift, what did they do? They squared the diameter and multiplied by the stroke of the piston in yards, and at once obtained the amount in lbs., as every yard upon the circular inch was a pound. Taking an 8-inch pump, the square was 64; it was making 10 yards per minute —64 gallons a minute—there they had it in a moment. Another instance, 1 inch of rain to the acre was 100 tons, or, to be more accurate, 101 tons."

When we come to the question of coinage, and of the application of the metric system to chemistry, the advocates for the decimal system are on safer grounds. We know from our own experience how convenient the decimal system has proved in monetary affairs, and a large majority of British merchants and manufacturers are already strongly in favor of converting pounds, shillings and pence into decimal coinage, which can be done without disturbing the sovereign as the standard coin. In practical chemistry the decimal system is already in actual use and is found to be a great saver of time, because of its convenience in getting percentages.

That the decimal system can be applied to many calculations with great advantage, and that one uniform system of measurements for the whole world would be a vast benefit to mankind, there can be no doubt. That the metric system is the ideal for such a universal system is questionable. A combination of the decimal system with changes that would simplify the present British standards, would more nearly reach this ideal, but as matters now stand, it is doubtful whether all the countries now using the metric system would meet the Anglo-Saxon portion of the world by such a compromise.

THE RACE FOR THE POLE.

The Canadian Engineer has contended that as the North Pole must be found, a Canadian should be the finder, for the terrestrial, as well as the magnetic pole, lies in Canadian territory. The hour has at length arrived, and with it the man in Capt. Bernier, of Quebec. Those who read the sketch of this hardy navigator, and his plans, outlined in another part of this number, will admit that he is no visionary, whose only qualification is the ambition to get there. He has studied the problem entirely from the practical side, as the details of his proposed vessel will show; and yet, as he frequently declares, he hopes to reach the pole not by his own genius altogether, but "by the help of God." This is the spirit in which such an undertaking should be carried out, and Capt. Bernier seems to have the right combination of courage and humility. He reminds one of those intrepid old adventurers of the French-Canadian race, who have left enduring monuments of their explorations over this continent from the Atlantic to the Great Lakes and from the shores of Hudson Bay down the Mississippi to the Gulf of Mexico, and it would be a happy culmination of the work of these brave pioneers of discovery in America, if it should be appointed to a French-Canadian to plant the flag of Canada upon the pole. Canadians of all races would rejoice that it should be so, and we trust the Dominion Government will provide Capt. Bernier with all he wants for this expedition.

THE REGULATION OF THE LEVEL OF LAKE ERIE.*

BY F. W. FARNCOMB, O.L.S., LONDON.

The necessity for increasing the safety, certainty and facility of the navigation of the Great Lakes and the deep waterways between them and the Atlantic tide waters, is one of the great undertakings of international importance which will require the immediate action of the Canadian and United States governments. The comparatively great variation, both annual and periodical, in the height of the water, in Lake Erie alone, involves enormous loss to the shipping interest as well as the expenditure of millions of dollars in deepening harbors, channels and waterways.

* A paper read before the Association of Ontario Land Surveyors.

How to regulate or minimize this variation is the subject of a special and exhaustive report prepared by Mr. G. Y. Wisner, a member of the United States Board of Engineers on Deep Waterways, from data gathered by this board, and endorsed by his colleagues, as a preliminary report upon the whole subject to be investigated, for which the necessary data and conclusions have not been completed. Records taken at Cleveland since the year 1865, up to the year 1898 inclusive, show that the mean elevation of the water in Lake Erie above mean tide at New York is 572.4 feet, and using the same datum, the highest mean monthly water mark, which was reached in 1876, is 574.3 feet, and the low water mark, reached in 1895 and 1896 was 570.6 feet. The greatest variation in the height of the water in the last 35 years was therefore 3.7 feet, and the mean annual variation, which continues about the same in recent years, is about 20 inches. The chief source of supply to Lake Erie is drawn from the Great Lakes above, which with their respective watersheds include an area of over 150,000 square miles, or about six times the area of Lake Erie and watershed; it is, therefore, the fluctuation in the supply from these lakes due to varying rainfall, ice, etc., which practically governs the variation of its water level. The flood water pouring into the upper end from the Detroit river, the lake water at normal height must rise until the sectional area and slope of the upper portion of the Niagara River, which forms the outlet, is increased till its capacity is equal to the increased supply from above, when the lake water level becomes once more stationary until the conditions are again changed.

It is evident that no matter what system be adopted for regulating the water to a uniform height, or in other words making the discharge equal to the supply, that the capacity of the Niagara River must be increased below the required lake level so that it will at all stages be sufficient to carry off the maximum supply. It is also evident that this can only be accomplished by deepening or widening its bed for a certain distance, or by raising the water in the lake above the river bed until a like result is obtained. With this result accomplished, by either method, means must be devised to regulate the discharge into this huge tail race when its full capacity is not required, so that it will equal the volume of water flowing into the lake. This can only be done by means of a dam and flood gates, in either case. For economical reasons alone, therefore, the scheme recommended for raising the water to or near high water mark, seems to be the proper one, apart from all important questions of the actual height which will be most convenient and beneficial to the majority of interests that will be affected.

By means of accurately measured cross sections of the river and careful observations taken at different stages of the water level, the volume of each mean monthly discharge from the lake has been accurately determined from the year 1865 to the year 1898 inclusively, and from these results the necessary height of the proposed submerged weir and width of sluice gates have been calculated, which fixes the height to which the water will have to be raised and maintained at 574.5 feet, or a little over 2 feet above the mean elevation and about 2 inches over high water mark; for the period referred to, which was reached in the year 1876. The location chosen for the proposed fixed weir and sluices will follow a rock reef which extends into the river from the breakwater of Black Rock harbor, Buffalo, for a distance of about 1,300 feet, and then deflecting about 35 degrees northerly, and running in at right angles to the Canadian shore, a total distance of 2,810 feet. Of this 1,600 feet will be a fixed weir, 1,040 feet will be sluice openings, and the remainder will be taken up by sluice gate piers. About 1,200 feet of the reef will be utilized at small cost for the proposed weir as it is about the required height, viz., 6.6 feet below the surface of the water when regulated to the height proposed. The river bed deepens suddenly at the end of this rock, and it is from there the piers and sluice gates will be placed. They will be 13 in number, 80 feet each in width, and have a depth of 20 to 24 feet. To each gate will be attached suitable hoisting gear and counter weights so arranged that the variation in weight due to immersion will be so equalized that the hoisting gear will only be required to overcome the friction, etc. So nicely will this adjustment be made, that it is stated two men only will be required to operate each sluice and the whole system will be opened in three-quarters of an hour. The piers, 52 feet long and 12 feet in width, will be built of concrete faced with granite, and paving stone will be carried up 9½ feet above the water, and upon these the steel superstructure, 40 feet in height, to carry the weights and hoisting gear, will be placed. The weir will be made with concrete, 5 feet wide on top with rounded crest with upper side sloped one to one, the lower side vertical, and both sides filled in with large stones. The foundation is upon rock bottom throughout.

In calculating the discharge in the last 35 years, it is estimated that the mean monthly discharge was 220,430 cubic feet per second, and the greatest mean discharge for the first six months (which occurred in 1876), 285,200 cubic feet per second. The volume of discharge over the weir with the water at 574.5 feet will be 113,400 cubic feet per second, which can be increased at will up to 159,500 cubic feet per second by opening the sluice gates and making the total discharge 272,900 cubic feet per second, exceeding by 1900 cubic feet per second the average supply for the storage season for any year excepting 1876. But it is pointed out that in the last six months of the year 1895 the discharge was 60,000 cubic feet per second less than the capacity of the proposed regulating works, which could then have lowered the water one foot in two months, and that this contingency, as well as those in the future, could be readily dealt with by lowering the water sufficiently during the season of limited supply, after navigation closes, to leave a safe margin for any extraordinary increase of supply in the coming season.

In conjunction with this work a channel and lock will be necessary on the Buffalo side of the river to a point below the gorge where it widens, and the current is slower, in order that vessels may pass around the works, and at the same time do away with the present dangers and difficulty in navigating the shoals and swift current in this part of the river. The estimated cost of the regulating work is about $800,000, while the cost of the 17-foot channel and lock, 600 feet by 60 feet by 21 feet, is estimated at about $1,600,000, or about $2,400,000 in all. The probable effect of the proposed works upon the lakes and waterways above and below is also one of great interest and importance. Perhaps the latter is more particularly so to Canada, for any further lowering of the waters of Lake Ontario and the St. Lawrence River would almost amount to a national calamity. While the report is not conclusive upon this particular point, the investigations in that respect not having been completed, it is claimed that regulation will not materially change the annual discharge through the Niagara River, and will only modify the distribution of flow about 5 per cent. of the average discharge, and therefore cannot materially affect the level of Lake Ontario and the St. Lawrence.

It seems that through the deepenings of the channels of the St. Clair and Detroit Rivers in recent years, the low water levels of lakes Huron and Michigan have been lowered one foot. It is estimated that the direct result of raising the level in Lake Erie 3 feet will be a corresponding rise of 2 feet in Lake St. Clair and 1 foot in lakes Huron and Michigan, thus restoring to the latter their former natural low water level previous to the year 1886, and at the same time diminish the fluctuations of these lakes one foot. It is shown also in favor of this scheme that the aggregate cost of improving Lake Erie harbors alone has averaged $1,000,000 for every foot in depth of permanent improvement, and also that the enlargement of the navigable channels of the St. Clair and Detroit River to a width of 600 feet, is at present a matter of urgent necessity, and the favorable effect that the proposed work would have in this instance also is apparent. The report states that the stage at which the lake level would be regulated, that is with an elevation of 574.5 feet above mean tide water, would be 6 inches below high water mark, but the date upon which this height was reached does not appear to be given.

CANADA'S STEEL.

Address by A. J. Moxham to the Canadian Manufacturers' Association, on Feb. 15, in the Board of Trade Rotunda.

A large and representative audience were assembled on the night of February 15th in the Rotunda of the Board of Trade Building, Toronto, to listen to a very able address by A. J. Moxham, the general manager of the Dominion Iron and Steel Company, and H. M. Whitney, the capitalist, who is president of the great company. Mr. Moxham is a clean shaven man,

prominent dark eyebrows, square, angular face and broad, powerful frame, with an air of confident strength of purpose. Mr. Whitney is tall, rather bulky figure, fresh faced, and with white clipped moustache. President P. W. Ellis occupied the chair and introduced Mr. Moxham, who was heartily received. He said:

Reduced to its final analysis steel is a product resulting from the application of man's labor to three raw materials, viz., ore, coal and limestone. These three ingredients by means of a blast furnace are converted into pig metal, and this in turn by means of the open hearth furnace into steel. Science to-day has acquired such control of the process that within wide limits it is capable of dealing with almost every quality of pig metal. The question of the percentage of phosphorous, silica, sulphur and other ingredients in the pig is to-day of far more importance in the light of the cost sheet than it is as any matter of necessity so far as the subsequent open hearth practice is concerned. It is, therefore, a fact, broadly speaking, that the cost of the finished steel varies with that of the pig metal. There are no two great steel districts in all the world wherein the proximity of the raw material and the distance from the market is the same. When the lake district was brought into notice as the most economical point in the central west for making pig metal Mr. Carnegie built his own railroad, known as the Pittsburg Bessemer Road, 155 miles long, connecting Lake Erie with Pittsburg, and it was announced that this had made Pittsburg a lake port. The 155 miles were still there. It is, therefore to a study of distance between materials that we must turn when investigating the advantages of any given location. In a nutshell, it is entirely a matter of freight. At the very outset we are brought face to face with one great lesson, viz., that nowhere has nature grouped in one spot the three raw materials in the proper economic quantity and of the proper economic quality.

There is ore and ore. There are beds of very poor ore, carrying only from 10 per cent. to 20 per cent. of iron—which is the thing we want—and carrying enough silica to give us a respectable sand beach all round Nova Scotia, and this is the thing we do not want. These beds are generally of indisputable extent, and they also generally lay quite close to coal. There are also good ores carrying from 50 per cent. to even 65 per cent. of iron with little or no silica, and low in phosphorus and sulphur, but these we find in Spain, Lake Superior or Ontario, and they do not lay close to the coal. Or if we do find them close to the coal, as in the Guysborough district of Nova Scotia, we find them pocketty and the beds of small extent. There is also coal and coal. There is coal like that of Central Kentucky and Illinois that will not coke well and is high in sulphur and ash, and there is coal like the Durham field of England, the Connelsville of Pennsylvania, that are the standards of excellence for steel making. And to these will be added before two years go by as an equally good standard for steel making the coal fields of Cape Breton. The poorer coals of Kentucky are near very good ores; the good coals of Durham are near the low grade ores of the Middlesboro' district. The native ore of Middlesboro' is taken out of the hills overtopping the works, but this ore will not run much over 25 per cent. to 30 per cent. before calcining, and does not exceed from 40 per cent. to 42 per cent. afterwards. I speak of the native ore because a large part of the ore used at Middlesboro' is imported ore, principally from Spain.

Our next step is the enquiry, "What is the permissible cost of these materials?" The answer is short. The ore and the limestone delivered on cars or boat (as the case may be) at the mine must be "cheap as dirt," and the coal must not be far from the same. This is to be taken literally, not figuratively. In the Messabi, the Birmingham, the Midlesboro', the Luxembourg and at the Belle Island mines the actual price of mining and putting the ores on cars is less than the traditional contractor's price for removal of earth. It costs more per cubic yard to do the shipping for the ore in the Messabi range than it does to mine the ore. The limestone should not cost over 25 cents a ton at the quarries. While there is greater latitude in coal, even this is within narrow limits. In the Connelsville district coal has been mined and put on cars under forty cents a ton. The cheapest steel centres of the world to-day are the following: In England the Middlesboro' district, in Germany the Luxembourg district, in the United States the Central West and Alabama districts. Of these districts the one which overshadows the others is that of the central west, of which Pittsburg costs may be taken as the exponent. We will base our comparison on this, and so doing will be on safe ground. The actual cost of the lake haul of about 1,000 miles is in the neighborhood of 50 cents per ton, or, say, five one-hundredths of a cent a mile. The actual cost of the railroad haul can be safely taken at four-tenths of a cent per ton per mile. We will, therefore, treat one thousand miles of lake water carriage as equal to 125 miles of railroad carriage. The heaviest item in water freight is the lay time of the steamers when loading and unloading. This will be realized when I make the statement that during the open or operating season a lake ore boat is in port about 50 per cent. of her time while operating on an average route 1,000 miles long. And this in a district noted for having every improvement for quick loading and unloading. If the route be a short one the percentage of lay time, and consequently the cost of the freight per ton mile must largely increase. With these deductions Pittsburg pays the following freight costs in the assemblage of raw material:

Ore—From mines to upper lake port, 80 miles railroad freight. From upper to lower lake port, 1,000 miles water freight, equal to 125 miles railroad freight. From lower lake port to works, 155 miles railroad freight. Making a total on one ton of ore of 360 railroad miles. It takes 1.70 tons of 60 per cent. ore to make a ton of pig metal. Therefore the latter calls for a total of 612 railroad ton miles.

Coal—From Connelsville district to Pittsburg, say 80 railroad miles. Taking the same quantity of coal, which is the amount that is used, 1.70 tons, gives 136 railroad ton miles.

Limestone—From the Tyrone district, 130 miles. Say one-half ton limestone per ton of pig equals 65 railroad ton miles. Adding these together we have: Ore, 612 ton miles; coal, 136 ton miles; limestone, 65 ton miles: total, 813 ton miles. At four-tenths of a cent gives a freight cost of $3.25 per ton of pig-iron made. Remember, again, this is freight cost, not the freight charged.

Now, where does Canada stand in this comparison as a steel manufacturer? If you will take a map and draw a line from British Columbia on the west to St. John's, Nfld., on the east, that line will run through four well-developed beds of ore of large quantity and of excellent quality, and all of them capable of being mined as cheap as dirt. They are related to the coal as follows:

(1) In British Columbia coal beds in the American district not far from Seattle are contiguous, and those of the Crow's Nest Pass on the Canadian side.

(2) On the northern shores of Lake Superior are large and pure beds. Part of these are in the hands of our new industrial captain, Mr. Clergue. This district is full of promise. It has only to bring its coal from the Connelsville or Pittsburg district, a distance of, say, 210 miles by rail to Lorain or Cleveland. Both ports are equipped with modern coal-loading plants. A short water haul equivalent to, say, 80 miles of rail haul will connect with the mines. On this basis 1.70 tons of coal at 200 miles equals 403 miles, which at four-tenths of a cent per mile gives a freight cost of $1.07, or $1.28 lower than the Pittsburg standard.

(3) In the Ontario district exists ore of great promise, within reasonable distance of the coal of either the Connelsville or Punxatawny districts. Independently of the local supply is the Canadian lake ore to draw from. As a result it is cheaper to assemble and make the pig on the Canadian side.

(4) In Belle Island in Newfoundland exists the now well known Wabana ore. The economical point of its manufacture is at Sydney, directly on the cove beds. The cost of assembly is as follows: Coal, nothing. Ore, 402 miles sea freight. Owing to the relatively short distance the lake basis will not apply, as lay time in proportion to sea time will be the heavier. The actual cost will be 40 cents a ton. Limestone, 15 cents a ton. We then have 1.8 tons of 54 per cent. ore at 40c., 72c.; one-half ton limestone, 7½c.; coal, nothing; total, 79½c. Let me say while passing that this is the lowest assemblage cost in the world for the tonnage under consideration. As against the Pittsburg cost it represents a saving of $2.45½ per ton. We have so far proceeded only to the manufacture. What of the market?

The British Columbia district would command the eastern export markets. These are to-day somewhat limited in tonnage, and of a great assortment in kind, and this condition would have to be catered to. In addition to this a certain zone of contiguous territory, which is rapidly growing up should form a good home market. The central district, including Ontario, has a home market at its feet, and this means much. Only a generation ago the consumption of iron per capita in the States was 34 pounds per annum. Last year it was 150 pounds per capita per annum, and this on the greatly increased population. But even now there is a market waiting for supply, one that stretches from the north pole to the south, from the east to the west, and it is one where tariffs do not go. I mean the ocean. The central district can take her share of this as represented by the Great Lakes. She can put a large part of her steel into ship plates, boiler plates and channels, and her pig into triple expansion condensing engines, and so develop her shipbuilding, and take her share of a trade even now knocking at the door. As to the Cape Breton district, situated on the seaboard, the whole wide world is her market, all of it.

And at this point we must again revert to our cost comparison. We based this on the price at Pittsburg. To compete for the export business Pittsburg must get to tide water. She is now 500 miles from this, and it will cost her $2 to get there. In dealing with the finished steel it must also be remembered that it takes about 1 1-10 tons of pig to make the steel. So taking 1 1-10 tons at $3.25, we have $3.57, to which add $2 freight on steel to seaboard, and we have $5.57, from which deduct Sydney's assemblage cost, 79½ cents, and there is left $4.78 as the net advantage in the cost basis. In actual practice this means more. We should further note that Sydney's tidewater will average about 1,000 miles nearer to the world's market than that of Pittsburg. In all conservatism it would be safe to call the commercial difference all of $6 per ton.

As is usual in every new venture, Sydney has had her share of the prophets of evil. We are now in operation, and are making an excellent quality of pig metal out of nothing except our own Wabana ore and Dominion coal. With the fact of what is doing permit me for a moment to weigh some of the prominent predictions of likely trouble, if not failure. First, we were told that, although Cape Breton coals had coked at Everett, the coke was unfit for blast furnace use. It would not stand the burden. As answer I would state that the third day after our start it was carrying the full burden; it has done so ever since, and will continue to do so indefinitely. We were further told that everyone knew that the coals were too high in sulphur. We did not heed much what everyone knew. We analysed the coal. We found it higher than Connelsville, but only economically washed out, and so erected a washing plant. The coal-washer not being ready, we determined to start without it, and we did so, making our coke out of plain, every-day, unwashed Cape Breton coal. Our flux we knew to be unusually pure, and we felt this was worth something in controlling the sulphur. Our second cast from the furnace put us in control of the sulphur. The fifth cast brought it down to 10-1000 of 1 per cent. For most purposes it is too low, not too high. In every other ingredient Cape Breton coal equals, if it does not exceed, Connelsville. In ash the unwashed coal gives us a coke with from 6½ per cent. to 7½ per cent. ash, as against 10½ per cent to 11 per cent. in the Connelsville; in fixed carbon, from 90¾ per cent. to 91 per cent., against 80½ per cent in the Connelsville. So much for the coal. Now for the ore. The exposed surface ore gives us an average of about 52 per cent. iron, and as high as 11 per cent. silica. Our friends sympathized with us having so much silica to deal with. But the same pure flux which controlled the sulphur took a whack at the silica. The slag is so thoroughly basic that it holds down the silica, and we would not object to having even a little more left in the iron. The phosphorus has been spoken of as too high for basic pig. A few years ago, before the division of open hearth practice into the primary and the finishing furnaces, this might have been true. It is not so to-day. In England and Germany iron much higher in phosphorus is used, and it is found that the basic slag which results is a valuable bi-product, and commands a high price as a fertilizer. It is questionable whether we have quite enough phosphorus in our pig to give us this slag, but if not it can be cheaply added. For some very special brands of foundry iron the market demands are extremely low phosphorus. This we must obtain by the admixture of a neutral ore with the Belle Island ore. This we have found almost at our doors—not in large beds, but as little of it will be needed enough is at our disposal. At Belle Island doubts were developed as to whether we had as much ore as expected. Every test-hole put down, every heading driven, has proved the continuity of the ore and its improved quality when under cover. The existence of the submarine bed is proved and certain. On an extremely calm, smooth day its borders can be traced to a large extent by the naked eye.

When Mr. Moxham had concluded the chairman called upon Mr. Whitney, of Boston, the president of the Dominion Steel Company, who in a short speech said: It was in the purchase of rails for the West End Street Ry., of Boston, that he had first met Mr. Moxham. Speaking of the Cape Breton enterprises he said they had the three materials, coal, lime and ore, and there were no advantages under which iron and steel could be more cheaply manufactured anywhere in the world. He knew nothing technically about the method of manufacture of iron and steel, but he had been connected for seven or eight years with the Dominion Coal Company, from which the present enterprise had originated. He was impressed three years ago with the fundamental facts that coal, lime and ore were available for the enterprise, and knew it must be successful. He believed it would, as a basic industry, advantageously affect every business in the Dominion.

A hearty vote of thanks was then passed to the lecturer. Mr. Moxham, in acknowledging the compliment, mentioned that his company were building five very large blowing machines. No bigger machines of the sort exist in the world, though some of equal size are in use in the United States.

IMPERIAL TRADE NOTES.

The following were among the enquiries relating to Canadian trade recently received at the High Commissioner's office in London. Addresses of the firms can be given on application at this office: A correspondent asks for information concerning the manufacture of soap, starch, candles, paper and turnery in Canada. An Ontario firm of farm implement makers who use French buhr stones for fork and hoe grinding are desirous of having the addresses of quarry owners from whom they can purchase scrap or waste. A Canadian correspondent asks to be placed in communication with parties in the electrical business who purchase amber mica. Enquiry is made for the address of someone in a position to dispose of a process for making pig ments. A German firm desirous of importing from Canada carriages, sporting goods, boat motors, etc., office, and other furni ture, toys, etc., will be glad to hear from Canadian exporters open to do business. A Canadian firm of windmill makers desire to obtain a market in Great Britain, for their goods. A correspondent at Toronto, who manufactures curtain pole trimmings, brackets, ends, rings, etc., asks for addresses of British curtain pole makers, who would be disposed to buy such fittings. A civil engineer at St. Catharines, Ontario, is open for engagement by capitalists, contractors, or engineers, who may desire examinations or reports on projects or works in Canada. The names of a few firms in Canada who are manufacturers of Manila trawl twines are asked for. Enquiry is made by a firm in the Midlands for the addresses of a few asbestos mine owners in Canada. A Leeds firm asks to be placed in communication with Canadian manufacturers of office files, roll top desks and other stationery requisites. They also require the names of good wholesale stationers open to buy manufactured stationery. A correspondent having a knowledge of the chemical process for the manufacture of asbestos and other millboards, desires to get into communication with Canadian asbestos mine owners and dealers who might be likely to require his services.

In a recent issue of The London Engineer, an Englishman tells his countrymen why he buys American tools, and emphasizes the selling power of good catalogues by the statement: "I am using a Sturtevant fan, which happened to be the first selected, and that on account of the excellent catalogue issued."

MASONRY DAMS AND RETAINING WALLS IN GENERAL, CONCRETE WORKS, ETC.

BY CHARLES BAILLAIRGE, M.A., F.R.S.C., M.CAN. SOC. C. E.*

(Concluded from last issue).

The power works above alluded to have all developed within the last five years, and so of the St. Lawrence Power Works at Massena, where the dam has an extent of over 700 feet. These works are remarkable as outstripping those at Niagara, where, under a head of 150 feet and turbines mounted on vertical shafts, the power developed to date, and though comparatively colossal, is but 50,000 h.p., while at Massena, instead of ten 5,000 h.p. turbines, or sets of turbines, and Westinghouse generators, the number thereof is to be 15, giving 75,000 h.p. with a capacity in the canal or head race of double that figure, or 150,000 h-p. Massena, it may be said, is on the American side, and at the head of the "Long Sault" rapids, the canal or head race being some 16,200 feet in length, with 6,000,000 cubic yards of excavation, now all but completed. The fall is 50 feet, and available head 40 feet, but the supply of water much greater than that which, from the same source, has been made available at Niagara, since the whole flow of the St. Lawrence or drainage from the Upper Lakes runs through the Niagara River to Lake Ontario, the delivery over the Falls being 18,000,000 cubic feet per minute. To utilize the available head the turbines at Massena are mounted on horizontal shafts, and deliver into a small river, the Grasse, which thus answers as a tail race for the outflow—though it still remains to be seen whether, as with the so-called drainage works at Chicago, there may not arise international difficulties incident on one nation robbing the other of so much water, which, instead of being returned to the St. Lawrence direct, goes off on a side issue; in one case from Chicago to the Gulf of Mexico; in the other, from Massena, as already stated, to the Grasse river at a distance of 3 miles or more from the St. Lawrence, while such action may also be fruitful of local complications by flooding the Illinois on the one hand and the Grasse river on the other.

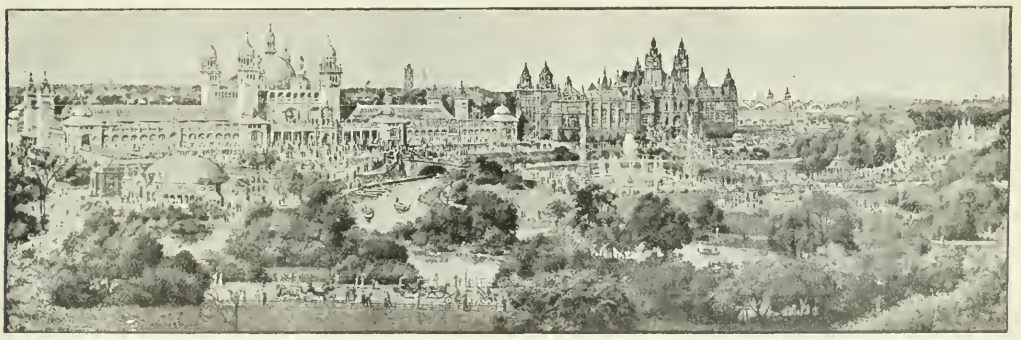
river, across a narrow gorge, where I could give the wall a curve in plan of only 100 feet radius. In such a situation the structure could obviously be made much lighter than say the Rankin type section for a long straight wall," which corroborates what I have just said of thus adding strength and resistance to a dam wall by throwing it into a bend up stream, and thus saving thickness and weight of masonry.

Mr. Mansergh also strengthens the writer's position on the unadvisability of horizontally coursed masonry in a dam, and the necessity of binding the masonry vertically, when in the same address he says, alluding to the new Croton Dam, which is not erected as at first intended, at Quaker's Bridge, but two miles further up the valley: "I have just received some photographs of this work, which represent the wall as being built in horizontal courses of roughly squared stones, a method which I do not approve. What we want in such a wall is ample weight, and good vertical binding, and this can be secured by building in stones of from two tons to six tons in weight, practically as they come from the quarry, and surrounding them with smaller stones and good concrete well rammed in so as not to leave any interstices."

He then goes on to say, alluding to dams which he is now building across the Elan River: "We are getting, in the Elan walls, say nearly 50 per cent. solid blocks, and the whole structure will weigh when complete 157 to 160 lbs. per cubic foot, and will practically be monolithic."

And finally, if it be argued that the writer, in assuming stone masonry to be only of double the weight of water, while it is in reality about 20 per cent. heavier, and that he is thus going beyond his own theory of weight of dam equal to twice that of water impounded, he can only urge his theory as rendering assurance doubly sure by thus further increasing the factor of safety.

This subject of dam building is becoming one of vast importance, as all the water powers of the country are being taken hold of for power purposes, or for water works, which are also power problems whereby water may be forced up to a given level without the cost of pumping, and as no one but an engineer can cope with such problems as the harnessing of the rivers of the world to give power to mankind—



GLASGOW EXHIBITION BUILDINGS AND GROUNDS.

But with this question we have not here to deal, and it is only introduced as a reminder to engineers that such river diversions be they only partial, may give rise to suits at law, when the engineer might be taken to task for not having foreseen the thing and advised his patrons thereof.

CURVED OR BOWED DAMS.

There is another class of dams where thickness is or may be partly compensated for by bending the dam up stream into a bow on the principle of a lock-gate of a canal. Such a dam occurs at Parsons, Kansas, where a masonry dam of 100 feet reach has been made convex up stream and to a radius of 200 feet. This dam is but 10 feet high, with a base of 6 feet; but as it is 2 feet thick at top, if a line be drawn through its vertical section from its outer edge at base to its inner edge at top, and the triangle thus cut off turned up-side down, and applied, thus increasing the base by 2 feet, the base will then be within 20 per cent. of being equal to the height, and the arched feature may be taken to make up in resisting strength for the want of sufficient base to conform to the writer's theory of "base of dam equal to the height or depth of water, including overflow, if any."

As to this practice of arching a dam horizontally or in plan, Mr Mansergh, President of the Institution of Civil Engineers, England, in his presidential address of November the 6th, says:—"In 1878 I built a small dam on the River Wyre . . . about 57 feet high above the

* A paper read before the Canadian Society of Civil Engineers.

the truth of the writer's motto, "The Engineer the master spirit of the age," heading an article of his which appeared in the "Canadian Engineer" of July and October last, and reproduced at page 293 of the London "Engineering Times" for September last, is indisputable for as he truly says in his last paragraph under the above heading:

"There is, however, another and more summary way of judging of the merits and qualifications of an engineer in comparison to those of persons exercising other callings. It is this: Of an engineer or almost any other man of common sense, you can make an alderman, a mayor, a premier, a president, a king, or a Kruger; and this at, so to say, a moment's notice; but of none of these can you make an engineer without years of study, practice and the keenest of observation."

THE GLASGOW EXHIBITION.

It is a question whether the exhibition at Glasgow this year will not be of more interest to Canadian engineers, and of more benefit to Canadian exhibitors than the Pan-American. If United States manufacturers can successfully invade the British market there is no reason why Canadians cannot do the same. As far as visitors are concerned there is no place in the whole of Europe of more interest to the civil engineer of this country than Glasgow, for there problems in civic govern-

CONTENTS OF THIS NUMBER:

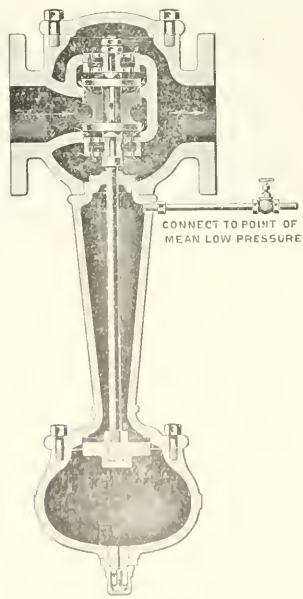
	PAGE		PAGE
Air Spring Pressure Regulator	234	Lake Erie Level, Regulation of	229
Aluminum, Progress of	iii	Magnetic Concentration of Ores	235
Arctic Expedition of Capt. Bernier	237	Marine News	240
Armstrong Craig Planet Tool	241	Masonry Dams and Retaining Walls in General, Concrete Works,	233
Atlas Pipe Wrench	234	Metal Trade of Gt. Britain with Canada	238
Camera, a Convenient Panoramic	242	Metric System	227
Canadian Railway Statistics	241	Oil Cup, New Pressure	244
Civil Engineer, What is a	xxxii	Ontario Land Surveyors Ass'n.	238
Conference Plan in Engineering Establishment	xxxiv	Paper Making, Chemistry of	226
Electric Flashes	247	Parson's Steam Turbine Reversing	243
" Railway Traction in Germany	iii	Personal	240
Friction in Water Pipes	243	Road Research, Canadians in	229
Gate for Approaches to Swing Bridges	244	Railway Curves, A Question in	230
Glasgow Exhibition	233	Railway Matters	245
Imperial Trade Notes	232	Railway Statistics, Canadian	241
Industrial Notes	245	R. & O. Navigation Co.	238
" primary of the 20th Century	225	Steel in Canada	230

A quantity of news and correspondence is unavoidably crowded out of this issue.

ment and municipal engineering have been wholly or partially solved, which have been the despair of workers in these spheres in other great cities of the world, and a trip to Glasgow for the study of these subjects alone will be worth the time and money. The exhibition will open in May and will last for six months. A feature of this exhibition is that, like the Colonial and Indian exhibition in 1886 it will not be competitive—that is, there will be no awards of medals or diplomas.

AN AIR SPRING PRESSURE REGULATOR.

Julian d'Este & Co., 25 Canal street, Boston, have placed on the market a pressure regulator for air or steam operated by means of the elastic properties of the air. The company give the following description of this interesting device: We have been testing about two years, with marked success, an improvement in pressure regulators, and are able now to furnish and guarantee regulators to work closer than any other, and to be perfectly noiseless in any building, especially in fireproof construction (which is so prone to transmit the least sound).



This result is accomplished by the substitution of an air spring, instead of the cumbersome and comparatively inaccurate regulation by means of weights and levers or metal springs. As shown in the cut, the air spring is formed in an airtight chamber, of which the diaphragm (which carries the main valve) forms one side. With a bicycle pump, air is pumped into this chamber, and its pressure on the diaphragm pushes the valve open, and holds it open until the low pressure on the opposite side of the diaphragm forces it to its seat. It is thus seen that any higher pressure is reached by simply pumping into the chamber, and any lower pressure, by letting air out of the chamber, while the air itself forms a singularly elastic and perfect spring, fully supporting every part of the surface of the diaphragm on one side, against the equal pressure of the fluid on the other side. The diaphragm thus is seen to be simply an elastic partition between two equal pressures, a very different thing from the ordinary arrangement, in which the flexible portion of the diaphragm is entirely unsupported on one side. The valve itself is double seated, perfectly balanced, and frictionless, and can thus be influenced by the slightest change in pressure, while the sensitiveness of the air spring is entirely controlled by the size of the air chamber.

The muffler principle (that has been successfully applied to locomotive safety valves), has been incorporated into the structure of this regulator—slightly increasing the size and fully accomplishing the purpose—hence we are able to guarantee a perfectly noiseless regulator, as well as an unvarying accuracy of pressure, regardless of initial pressure fluctuations. The purposes to which it may be applied are as various as the wants of steam users. The most common and obvious is in steam heating, where it is used to reduce any varying high pressure to any constant low pressure that may be desired. By its use steam may be maintained in the boilers at high pressure sufficient to run a steam engine or elevator, and yet be reduced for heating to atmospheric or very low pressures, thereby entirely preventing the snapping and cracking in radiators and heating pipes which is so disagreeable and dangerous, also preventing the wear and cutting of the seats of the globe valves. In the best recent engineering practice, the exhaust steam of the engine and elevator is turned into the heating system of the building, and the regulator automatically supplies just the amount lacking to maintain constant low pressure, say at atmospheric or even below, thus making the regulator eminently suitable for the patent vacuum systems now in vogue for economical low pressure heating. If the exhaust is sufficient, the regulator remains closed. If the weather becomes colder, or more rooms are heated, or the engine shuts down at noon or night, the regulator opens automatically, and maintains the pressure at which it is set.

In cotton, woolen and paper mills it is used on slashers, etc., and in dry rooms to reduce the pressure in the cylinders to the desired amount, and thus prevent the danger of bursting the cylinders. It maintains a uniform pressure whether the machine is running or not. In dyehouses it is used to reduce the pressure of steam on the dye tubs, and it will deliver from high pressure boilers (say 70 to 100 pounds) to the dyehouse exactly the same as though it were being delivered from low pressure boilers, through the same pipes. In rubber works it is used to maintain a uniform temperature in vulcanizers and dry rooms, and in connection with our steam trap (which instantly and constantly relieves pipes of all water) maintains a more even temperature than can be maintained by hand. On electric light plants they are used to reduce a varying, unsteady boiler pressure to a uniform pressure, incidentally re-evaporating any entrained water, and giving dry steam to the cylinders. On steamships they are used for steam heating pipes, steering engines, electric light engines, hoisting engines, cooking, etc. In short, for universal application to all the varied and various conditions under which a reduced pressure of steam, water, or other fluid is required, this air-spring regulator has no equal. It is compact and self-contained, without levers, weights or projections. It has no drip or leak of steam or water. All that passes into it passes through it, without waste or loss. It has no glands or packing, and the seat may be made of any suitable material for steam, water, or any other gas or fluid.

THE ATLAS PIPE WRENCH.

The Atlas Pipe Wrench, illustrated here, has new features distinct from any wrench on the market. It is as effective when fully extended for large sized pipe as when used for the smaller sizes. The jaw is movable, as will be seen, and can be placed in either of the three slots according to the size of pipe to be wrenched. The movable jaw is not a screw jaw, and therefore

has no weak points. These wrenches are made of a special wrench steel, drop-forged. Every one is tested before leaving

the manufacturer. They are easily and quickly adjusted, and, it is claimed, are superior to all other wrenches in strength, durability, simplicity and effectiveness. They are made in four different sizes, viz., 10, 18, 24 and 36 inches, and will take from ⅛ inch wire to 4½-inch pipe. They are sold at $1.40, $2.50, $3.75 and $7.50 each, respectively, by the Aikenhead Hardware Co., 6 Adelaide street east, Toronto.

MAGNETIC CONCENTRATION OF ORES.*

The Wetherill Magnetic Concentrator in McGill Ore Dressing Laboratory.

BY E. ANDREWES, B.SC., DEMONSTRATOR IN MINING AND METALLURGY, M'GILL UNIVERSITY.

The Wetherill magnetic concentration process differs from all other methods of magnetic concentration in that it makes use of a much more highly intensified magnetic field, whereby minerals and chemical substances of such low magnetic permeability that they have heretofore ordinarily been considered non-magnetic, are separated from one another, and from substances which are entirely inert under the influence of the magnets.

As early as the beginning of last century physicists had noted the magnetic properties of other substances than those easily attracted by ordinary magnets, such as iron and magnetite. Faraday carried on a set of very exhaustive experiments, making use of the most delicate physical apparatus, the results of which he published in 1846. He showed that all matter, solid, liquid or gaseous was magnetic, i.e., either attracted or repelled by the poles of a magnet. He accordingly made the division into paramagnetic and diamagnetic substances, the former being those attracted, and the latter (by far the greater number), those repelled.

The paramagnetic substances, including the majority of mineral species, may be divided into two classes: (1) Those that are highly magnetic; (2) those that are only feebly so. The first class is complete with the substances iron, nickel, cobalt, magnetite and pyrrhotite. Some idea of the gap between these two classes will be given by the following table, drawn up by Delerve (Annales des Mines, IV. Ser., Vol. XIV., p. 429). Taking the magnetic attractability of steel at 100,000:

Magnetite	65,000
Siderite	120
Hematite	93—43
Limonite	72—43

The knowledge of the paramagnetic property of these substances of the second class has been one of great scientific interest, and has been made use of to some extent in the mineralogical laboratory, but Mr. Wetherill has been the first to employ it for a commercial process. The object he had in view in inventing the machine was the treatment of the franklinite ore of Sussex County, N.J.

This ore is a mixture of franklinite ($FeO\ ZnO\ MnO$), ($Fe_2O_3\ Mn_2O_3$), will emite ($Zn_2\ SiO_2$), and calcite with smaller amounts of zincite (ZnO), fowlerite ($Mn, Zn\ SiO_2$), tephroite ($Mn_2\ SiO_2$) and garnet.

The problem was to obtain the zinc bearing minerals willemite and zincite as free as possible from the franklinite, garnet, tephroite and fowlerite, the iron-manganese bearing minerals, the presence of the latter being fatal to the direct production of metallic zinc. After much experimenting Mr. Wetherill succeeded in accomplishing this result successfully in 1895.

The machine as placed in the McGill laboratories differs from his original type, both in the form of the magnets, and their position with regard to the necessary belts, whereby the ore is brought into the magnetic field, and the products discharged. The McGill machine is intended for experimental work, and as far as the writer's knowledge goes is of a different design to any that have been used in practice, though the physical principles of the process are of course precisely the same.

Figs. 1 and 2 illustrate the arrangement of the magnets and belts. $P_1\ P_2$ (Figs. 1 and 2), are the pole pieces of two electro magnets, and $B_1\ B_2$ the cores and spools of these magnets. The following information has been supplied by the makers: Each spool is wound with thirty-five layers of No. 12 Browne & Sharpe gauge D.C.C. copper wire. The two spools average 115

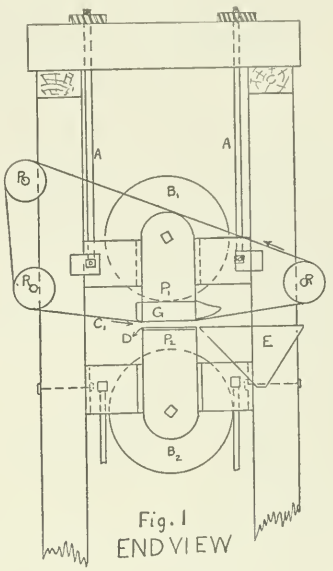


Fig. 1
END VIEW

turns of wire per layer. The two magnets are so wound as to give with 4 amperes of current an exciting force of 32,200 ampere turns. It has been found by experience that a greater number of ampere turns for a pair of magnets with cores and pole pieces of the size employed in this machine does not increase the intensity of the magnetic fields to any noteworthy extent. The cores and pole pieces are of wrought iron, and are of the following dimensions: cores, 6 in. diameter, 12⅝ in. long; pole pieces, total length 12 in., width 6 in. and 5 in. thick. The upper pole pieces are tapered at the bottom 45° on each side. What would otherwise be the angle of the pole piece of the first pole is rounded to a radius of ½-inch. The pole piece of the second pole is correspondingly rounded to a radius of ¼-inch. The lower pole pieces have their upper long edge rounded to a radius of 1-inch.

This pointing of the pole pieces of the upper magnet is perhaps the most important feature of the machine, as by reason of it is produced the highly intense magnetic field which is the peculiar feature of the machine. The bringing of the pole pieces to a point or rounded edge forces a great number of lines of force through this contracted area, thereby producing a very highly intensified magnetic field. GGGG are pieces of brass screwed on to the sides of the pole pieces of the upper magnet to afford a smooth rounded surface for the cross belts $C_1\ C_2$ to run on.

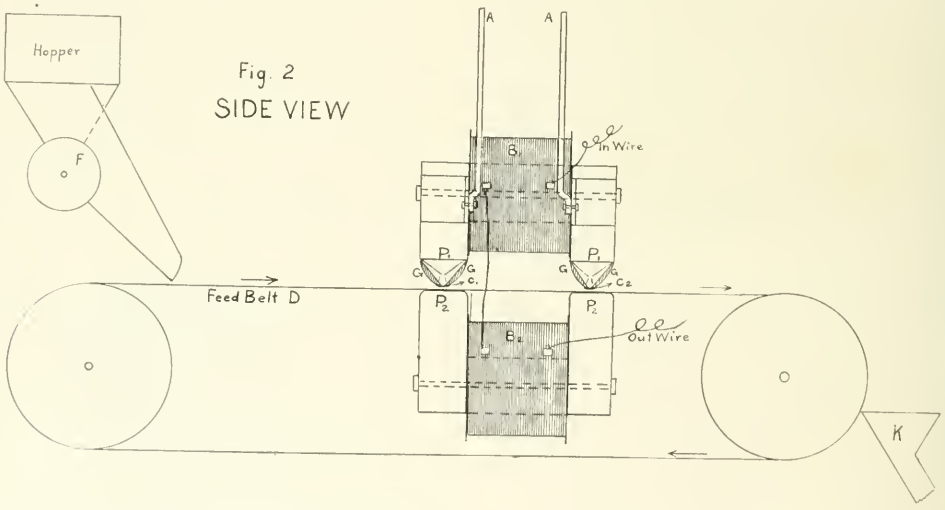
In operation the ground ore is fed regularly on to the feed belt D, which carries it into the field of the magnets. The magnetic particles are attracted by the intense field of the upper magnet, are picked up from the feed belt, and cling to the cross-belts $C_1\ C_2$, which move along the face of the pole pieces at right angles to the direction of D. The magnetic particles cling to the cross-belts as long as they remain where the magnetism is intense enough to hold them, then they drop from the belt into the hopper E. These cross-belts are made of one thickness of canvas, coated with rubber, and are quite thin. The non-magnetic portion of the ore remains on the belt D, and is carried over and deposited in the hopper K. The lower magnet is fixed, bolted to the frame, while the upper is hung from the

* Paper read before the Applied Science Society of McGill University

rods AA, and can be moved up and down at will. The intensity of the magnetic attraction acting on the ore on the belt can be adjusted by altering the distance of the magnets from the belt, or by changing the amperage of the current passing through the magnets by means of a rheostat. A third adjustment can be made by changing the speed of the feed belt, which has of course a most important effect on the capacity of the machine, the layer of ore to be separated being necessarily very thin. By making the proper adjustments a whole series of minerals can sometimes be successively picked out of an ore or rock. Beginning with low amperage and the magnets a good distance from the belts, we can gradually increase our amperage and move the magnets nearer the belt, thereby getting a series of minerals of gradually diminishing magnetic permeability.

I will now give some results that have been obtained with the machine at McGill. A test was made by students on a sample of franklinite ore. The ore was crushed through a sieve of ten meshes to the inch, and then divided into several sizes by screening, and each size passed separately over the machine. The result was that in each case a magnetic product was obtained containing nearly all the franklinite and other iron-manganese minerals, the zincite and willemite passing into the non-magnetic tails which were practically free from iron manganese minerals. This is precisely the separation that Mr. Wetherill sought in inventing the machine.

One of the most interesting applications of the concentrator is in the separation of zinc blende and galena, a problem



that has long been the bugbear of millmen the world over. In the case of an Ontario lead ore which was tested in the laboratory, a middle product of mixed zinc blende and galena was formed by jigging. By crushing small enough to divide the blende and galena into separate particles, and passing the ore through the magnetic separator, a practically complete separation of the blende and galena was obtained, the blende being the magnetic product. It is said to have been made use of successfully in treating the ores of the Broken Hill mine in Australia. Some tailings from this mine are now under treatment in the laboratory here. These tailings consist of zinc blende, with a certain amount of galena, rhodonite, garnet, and a quartz gangue. The material has been crushed to pass through a 20 mesh sieve. A separation was readily effected with the Wetherill separator into three products:

1 Magnetic heads, containing all the rhodonite and garnet, and a small portion of the zinc blende.

2 Almost entirely zinc blende, but carrying 7.7% lead.

3 Quartz gangue carrying the rest of the galena and a little blende.

It is probable that with finer crushing the 2nd product could be made to go considerably lower in lead, the lead being probably present as galena included in grains of blende. The machine has also been made use of at McGill for extracting the magnetic constituent from a corundum ore from Hastings county. In separating the various constituents of some rock from the Villeneuve Mica Mine, and in the concentration of certain black sands from placer workings, reports of which tests are to appear in the summary report of the Canadian Geological Survey.

I would refer those who are interested in this phase of magnetic concentration to a paper, entitled "The Magnetic Separation of Non-Magnetic Material," by H. A. J. Wilkens and H. B. C. Nitze, in the Transactions of the American Institute of Mining Engineers for 1890, and also to one by the last named gentleman in the Journal of the Franklin Institute, April 17, 1897. In the latter article Mr. Nitze speaks of the successful use of the Wetherill Concentrator in the following cases:

(1) The separation of certain zinc minerals from the other injurious constituents of an ore, as at Franklin.

(2) The enrichment of red and brown hematite ores.

(3) The concentration of a silver lead ore with a limonite gangue.

(4) The concentration of manganese ore.

(5) The separation of a mixture of apatite and rutile.

(6) The removal of rutile and garnet from a monazite sand.

(7) To obtain pure garnet from garnetiferous rocks and schists.

(8) Garnetiferous copper ore from Mexico.

(9) Corundum ores, from which garnet and other deleterious ferruginous minerals were to be removed.

(10) Ores containing siderite, as in cryolite from Greenland

A QUESTION IN RAILWAY CURVES.

Editor Canadian Engineer:

Sir,—There is a question in the report of the O. L. S., page 72, for the year 1900, styled, "Railway Curves." It may be I do not understand the question, but I do not come to the same conclusion the author does. "It is proposed to connect

two tangents by a curve on a railway survey." The tangents form an angle of 84°, and from the point of curve to where the tangents meet or join 745 feet. I make the radius 670.8, diameter 1341.6, and the curve for 100 feet chord 4° 16' 3". I think it would be well to know what others make of it. I give a drawing as I understand it.

Ridgetown, Ont. Thos. Scane.

CAPT. BERNIER'S ARCTIC EXPEDITION.

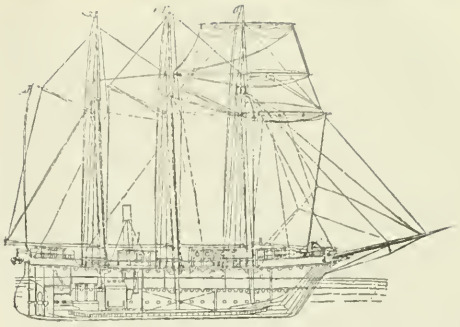
Capt. Joseph Elzear Bernier, who proposes to start for the North Pole next year, is a native of Quebec and comes of an old sea-faring family. His grandfather and father were sea captains, and if the service of himself and immediate relatives as captains of vessels could be extended in one life, that life would make a period of 325 years. Capt. Bernier is 48 years of age, and though somewhat below medium stature, is solidly built, and a powerful and vigorous man. He has spent almost his whole life on the ocean or fresh water, and as most of his family have attained an extreme old age, he may be said to be in the prime of life. He has been a captain of vessels since the age of 17, and has since attaining that age commanded no less than 45 different vessels, ranging from river boats and whalers to steamers of several thousand tons. In all this time he has lost but one vessel, and in this case was commended by its owners for beaching the boat in order to save the lives of the crew. Capt. E. B. Hatfield, who writes to the Liverpool Journal of Commerce commending Capt. Bernier's plans, thus speaks of

CAPT. J. E. BERNIER.

him: "I knew his family and people in Quebec some thirty years ago. He belongs to a family of hardy sea-farers for three generations back. He has had a varied and valuable experience, not the least of which was as chief officer with me in the steamship "Southern," under my command, when we encountered the great hurricane of August 24th, 1873, on the American coast, which destroyed nearly everything in its track—upwards of a thousand vessels. But by the mercy of God, and great efforts, we came through unhurt. He is a total abstainer and non-smoker. I have looked through Capt. Berner's plans, and think he will succeed."

Nearly all recent authorities on polar research agree on two points, first, that the North Pole is not inaccessible, and second, that in the remote past human beings have not only visited it, but have probably resided in that region for some time. The registered temperatures taken nearest the pole on recent Arctic expeditions are considerably higher than has been recorded in the Canadian Yukon, where thousands of our citizens have lived for several years. The chief points in present day expeditions will be the maintenance of supplies, and the co-operation with nature in taking advantage of the polar currents. The expeditions of the past half century have increased our knowledge of these currents and other conditions, and Capt. Bernier is taking fullest advantage of the experiences and failures of the past. That he has studied these records to good purpose is evident by the design of his proposed vessel, which embodies the best features of previously built ships, while providing against those weak points that have been disclosed by Arctic navigators.

The accompanying cut is a sectional view of the proposed ship, which will be 100 feet long on the keel, or 110 feet over all, 36 feet beam and 18 feet depth of hold. She will be a ship of 300 tons net, and will run under both sail and steam. Her engines will be 300-h.p. triple expansion, with boilers, 10 x 12, built for 180 lbs. pressure. This will furnish 100-h.p. more than the engines of the "Fram." The hull will be different in design to that of the "Fram," whose stern overhung the stern post by 13 feet. Capt. Bernier's ship will have a perpendicular double



SECTION OF CAPT. BERNIER'S PROPOSED SHIP.

stern-post, with rudder outside, so that either the rudder or propeller can be unshipped at any time. This will be a great advantage, as much difficulty was encountered by the rudder and screw of the "Fram" getting frozen up while jammed in ice, while the "Fram's" build rendered her stern weak. Capt. Bernier's vessel will also have a flush deck, instead of the style shown in the accompanying engraving of the "Fram," which rendered her liable to the frequent flooding of the forward deck by water and slushy snow, causing no end of trouble to the crew and overweighting the vessel with an unnecessary load. Capt. Bernier's engines will not only be more powerful but better protected than other Arctic vessels. She will have three tiers of beams about her engine and boiler room. There will be three beams over the boiler, three placed side by side to carry the step of the mizzen mast, and at the same time to strengthen the ship between the boiler and engine room, and three other beams will run across the engine room over the cylinder to protect it. The following will be the materials in the construction of the hull: Oak for the frame and top planking, oak for the two lower beams and pitch pine for the upper beams, elm for planking below the water line and inside ceiling below water line, pine for the deck and elm and pitch pine, with steel fastenings, for ceiling in hold. For a space of 30 feet around the observatory the fastenings will be of copper instead of steel, for safety in magnetic observations. The knees will be of tamarac and the masts of Oregon pine. The bow will be armored with a plate of steel on each side, the stem being covered with a plate of steel overlapping these two. There will be a spare rudder, a spare screw and a diving outfit. The last named item was much missed by DeLong in the voyage of the "Jeanette," whose forefoot broke, springing a leak which could not be repaired for want of such an outfit. She will have three masts

THE FRAM.

the same as the "Fram," and her total area of sail will be 7,000 square feet, or 1,000 feet more than that of the "Fram." Her sails will give her more driving power, not only by reason of her extra canvass, but by the style of rig, as her foremast will have three yards, enabling her to run before the wind or back out of a field of ice better than the "Fram." Her rig will resemble that of a three masted top-sail schooner, which is considered the best all round coaster. The masts will be about 100 feet high, but the top masts are made to take down, thus reducing their height to about 60 feet. She will be provisioned for a five years' voyage, and will have a crew of 14. These will consist of six scientific men, including a surveyor, astronomer,

geologist, biographist, artist-photographer and doctor, all chosen as far as possible with a view to their practical as well as scientific knowledge. There will be three navigators all being qualified as captains; three sailors, one engineer and one assistant engineer who will be a mechanic and electrician. The "Fram" had only three scientists on board. It is intended to take an outfit of wireless telegraphy. The vessel will be built somewhere in Canada, and will leave Victoria or Vancouver, B.C., about the 1st of May, 1902, in time to enter Behring Straits about the 1st of July. From Port Clarence in Behring Straits she will sail parallel to the Siberian coast to about 170 degrees west longitude, thence she will steer north, crossing the track of the "Jeanette" until she strikes a point in the current which will take her to or near the Pole.

METAL TRADE OF GREAT BRITAIN WITH CANADA.

The following are values in sterling money of the exports of metals, etc., from Great Britain to Canada for January, 1900 and 1901:

	January 1900.	January 1901.
Cutlery	£4,558	£3,290
Hardware	2,068	2,044
Pig iron	2,090	827
Bar, etc	1,100	291
Railroad	321	....
Hoops, sheets, etc	2,005	736
Galvanized sheets	5,736	1,266
Tin plates	14,738	10,215
Cast, wrought, etc., iron	3,201	2,511
Old (for remanufacture)	2,485	....
Steel	22,449	4,230
Lead	1,052	1,476
Tin, unwrought	3,377	2,407
Alkali	2,691	....
Cement	272	....
Imports of Great Britain from Canada:		
Pulp wood	6,288	19,134
Wood, hewn	7,085	3,888
Wood, sawn	47,485	75,392

RICHELIEU AND ONTARIO NAVIGATION CO.

At the annual meeting of the Richelieu & Ontario Navigation Co., the following directors were elected: L. J. Forget, president; Wm. Wainwright, vice-president; R. Forget, Col. F. C. Henshaw, C. O. Paradis, J. K. Osborne, W. Hanson, Hector Mackenzie, E. B. Garneau and Joseph Louis.

At a special meeting, held after the annual meeting, it was resolved to issue $417,600 new stock. The new capital will be used to pay for the new steamer "Kingston," now in the course of construction, as well as for the completion of the company's Murray Bay hotel and other permanent improvements. This will increase the paid-up capital from $2,088,000 to $2,505,600.

On the Montreal and Quebec line, the steamers "Montreal" and "Quebec" are being renovated from stem to stern In another year the "Montreal" will be replaced by a large and magnificent steamer, which is now being laid down at Toronto. On the Saguenay line the steamer "Canada" is being rebuilt All her dark staterooms are done away with, and replaced by rooms with windows. This is rendered possible by replacing her old-fashioned wheels with small feathering wheels. The Hamilton line will consist of three boats a week instead of two, as formerly. These steamers run the rapids the same as the mail line boats. This route will be made up of the steamers "Hamilton" and "Algerian," just as last year, with the addition of the "Spartan," which is being overhauled and having feathering wheels put in. The Company have made the following appointments for the fleet for the coming season:

Steamer Quebec—Captain, L. O. Boucher; engineer, F. Gendron.

Montreal—Captain, Louis St. Louis; F. X. Hamelin, engineer.

Berthier—Captain, Charles Gouin; E. Arcand, engineer.

Chambly—Captain not named; C. Gendron, engineer.

Terrebonne—Captain, C. Laviolette; M. Beaudoin, engineer.

Trois Rivieres—Captain, F. St. Louis; J. Matte, engineer.

Carolina—Captain, Geo. Riverin; M. Latulippe, engineer.

Canada—Captain, Jos. Dugal; E. Denis, engineer.

Saguenay—Captain, Charles Lapierre; M. Hamelin, engineer.

Laprairie—Captain, P. McLean; de Martigny, engineer.

Hochelaga—Captain, H. Mandeville; engineer, Pintal.

Longueuil—Captain, F. Jodoin; engineer, H. Noel.

Sorel—Captain, F. Faubert; engineer, E. Beaucage.

Mouche-a-Feu—Captain, F. Crepeau; engineer, T. Mathieu

Cultivateur——Captain, Jos. Gouin; engineer, Chapdelaine.

Hosanna—Captain, D. Mongeau.

Toronto—Captain, Harry Grange; chief engineer, W. Black.

Bohemian——Captain, A. Dunlop; engineer, Gendron.

Caspian—Captain, J. McGrath; engineer, N. Beaudoin.

Algerian—Captain, D. Mills; engineer, Wm. Parker.

Hamilton—Captain, Andrew J. Parker; R. Marshall, engineer.

Kingston—Captain, Henry Esford; A. R. Milne, engineer.

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The annual meeting of the above association opened on February 26 at the association's repository in the basement of the Parliament buildings, Toronto; the second and third days' sessions being held by courtesy of the Engineers' Club of Toronto in the rooms of that club, King street west. The following were among those in attendance: President, Geo. Ross, Welland; vice-president, James Dickson, Fenelon Falls; G. B. Kirkpatrick, chairman of council, Toronto; E. G. Barrow, Hamilton; W. R. Aylsworth, Belleville; James Warren, Walkerton; J. D. Evans, Trenton; C. A. Jones, Petrolia; H. McGrandle, Huntsville; V. M. Roberts, St. Catharines; G. B. Abrey, Ignace; C. D. Bowman, West Montrose; H. J. Bowman, Berlin; A. R. Davis, Napanee; H. H. Gibson, Willowdale; H. DeQ. Sewell, Rat Portage; J. Hutcheon, Guelph; R. McDowall, Owen Sound; J. Robertson, Glencoe; W. V. Turner, Gananoque; H. B. Proudfoot, Port Arthur; V. Sankey, W. Spry, W. A. Browne, C. J. Murphy, R. P. Fairbairn, J. F. Whitson, A. P. Walker, H. L. Esten, K. Gamble, A. J. Van Nostrand, W. Chipman, of Toronto, and many others. The morning of the first day was taken up with the meeting of council (G. B. Kirkpatrick, of Toronto, in the chair), and receiving reports of standing and special committees.

The report submitted by the Committee on Repository and Biography acknowledged the generous treatment of the commissioner of Crown Lands in providing new and better quarters in the basement of the Parliament buildings; they also reported that biographies had been compiled and photographs secured of many surveyors.

The president in the course of his annual address congratulated the association on the good programme of topics prepared for this meeting. He was pleased to see that the attendance was kept up so well, although out of a total active membership of 220 only about 1-5 usually attended the annual meeting. The records of past meetings show that there are many members who have never attended any meetings or ever prepared a paper He trusted that a consideration of these facts would stir up a large number of these members to become active members in reality as well as in name, and thus show their appreciation of the benefits conferred by the institution Referring to the Queen's death he said, "There are few of our members who can remember having any other sovereign. We have all taken the oath of allegiance, and can look back with pride to having lived in the Victorian Era, under a Queen who commanded the reverence and love of not only her own people but the people of all lands; her virtues and devotion have been a perpetual lesson, and will remain an undying heritage In the neighboring republic, a land that once formed a part of the British realm, and that later fought against it in deadly strife, this granddaughter of George III was mourned for by rich and poor alike." He recommended that a suitable memorial

be prepared for transmission to the throne, testifying to the great love and affection in which our late sovereign was held. King Edward VII. would no doubt prove a worthy successor to his illustrious mother. Among the members removed by death, during the year were the following: T. O. Bolger, Kingston; D. B. Brown, Cornwall; J. McCallum, Fort Francis; J. M. Tiernan, Tilbury Centre, and W. S. Davidson, Sarnia. He noted with pleasure the progress of the Good Roads Association, formed in 1894, and it was gratifying to see such an improvement in the highways of the province under the encouragement given by the province. There was still much room for improvement in many parts of Ontario. During the past season several of our members have been engaged in exploring the northern part of this province, and their reports will probably show vast tracts of mineral timbered and agricultural lands. Extensive subdivision surveys may be looked for at an early date in this region, and when New Ontario is opened up by the projected railways the hum of mills and mining plants will be heard in the land. After referring to the South African war he expressed his pleasure in having present Captain Bernier, who would address the association on his proposed polar expedition, in which it was satisfactory to know that the Dominion Government had become interested. Capt. Bernier's work would be followed with the heartiest sympathy of this association, and if he did not succeed where all others had failed he would at least reflect credit and honor on himself and his country.

The second day's session opened with the report of council and board of examiners made by the chairman, G. B. Kirkpatrick, by which it appeared that the following are the candidates who have passed the required examinations: Preliminary—C. Adams, Brantford; A. S. Code, Alvinston; A. H. Greenlees, London; M. E. Brian, Windsor; C. B. Clark, London Junction. Finals—J. H. Jackson, Windsor. Bonds approved and filed—C. W. McPherson, F. D. McNaughton, J. H. Shaw and M. B. Weeks.

H. J. Bowman, of Berlin, then read an instructive paper on "Surveys and Plans for Municipalities," of which the following is a summary:

Those sections relating to municipal surveys form an important part of "The Surveys Act." Particular attention is directed to sections 10 to 13 of the act, relating to boundary lines of townships, and to section 14. In 1897 an important addition was made to this section as follows: (4) On the return of such survey to the commissioner of Crown Lands he shall cause a notice thereof to be advertised once in each week for four weeks in some newspaper published in the county town of the county in which the lands lie, and shall specify in the advertisement a day not less than 10 days from the last publication on which the report of the survey will be considered, and parties affected thereby heard, and on the hearing the commissioner may either confirm the survey or direct such amendments or correction to be made as shall seem just, and shall confirm the survey so amended or corrected, and the lines or parts of the lines so surveyed and marked as aforesaid, shall thereafter be the permanent boundary lines of such concession or side roads or part of concessions or sideroads to all intents and purposes of law, whatsoever, and the order of the said commissioner confirming the said survey shall be final, and conclusive upon all parties, and shall not be questioned in any court whatsoever; 60 Vic., Chap. 27, Sec. 14.

Previous to this amendment to the act these municipal surveys had much the same standing as surveys for private individuals, but now, no doubt there will be applications for many more.

Section 15 deals for the first time with angles of lots, and all surveys under this section are to be confirmed in the manner provided in the previous section. The foregoing refers to those portions of "The Surveys Act," known as "Municipal" surveys. It is evident that these sections of the act apply only where the original survey was made by the Crown, and there is no question but that they will be in the interest of the people at large. Many towns and villages in this province were laid out for private individuals many years ago, and now the street lines are in many cases obliterated. Some means should be provided so that the councils of all municipalities may have resurveys made; also in many towns permanent cement walks and other street improvements are being made without having the street lines properly defined. The writer would suggest that in all cases the application of the municipal council be to the County Judge who would appoint an Ontario land surveyor to do the work. On the return of the survey the County Judge should cause a notice to be advertised in some newspaper, and specify the day when the report of the survey will be considered, and the parties affected thereby heard, after which the survey, being amended if necessary, would be confirmed. In 1897 an important amendment was made to this section, so that now surveyors must follow the method adopted in making the original survey as shown on the plan of same. This would be filed in the Registry Office, and could easily be produced at the County Judge's chambers should it be necessary when a survey is being confirmed.

W. R. Aylsworth, Belleville, reported, as chairman of the Committee on Land Surveying, to the effect, that seven papers containing questions had been under consideration in which the committee submitted their conclusions. The committee referred to the council for favorable consideration, John McAeree's communication on "Ontario's Manual Surveys."

The afternoon session opened with the reading of a paper on "Regulation of the Level of Lake Erie," by F. W. Farncomb, of London, Ont. which will be found in another column. In the absence of the author the paper was read by J. W. Tyrrell.

C. A. Jones, of Petrolia, on behalf of A. S. Code, chairman, presented the report of the Committee on Drainage, in which it appeared that drainage work had not diminished durthe year, nor had litigation decreased. The committee suggested the publication by the Provincial Government of a report of the principal drainage works during the year. The provisions of the drainage act are gradually getting better definitions in the courts through the decisions in the courts in contested cases, and this appears to be the only compensation for the number of lawsuits now arising, Work under the "Ditches and Watercourses Act" is apparently in no better condition than heretofore. Some time ago section 28 of this act relating to the non-completion of work was amended by inserting the clause, "or at any time not later than six months after the time fixed for the completion of the ditch." The working of the entire act is blocked by this insertion after the time limited has expired, and the engineer has no authority to let the uncompleted parts; and the only course clear is a new award, with its attendant risks; an extension of the time should be made or the clause omitted entirely.

M. J. Butler, chairman of Committee on Engineering, made a short verbal report and took up the question of the metric system in an instructive talk in which he pointed out some of the difficulties of the metric system, particularly in its application to engineering work. A vast mass of literature had accumulated under the present system, and if the metric system were adopted all these elaborate works would have to be compiled afresh. He quoted from Sir Frederick Bramwell to show that the metric system was much more cumbersome than our present system in some respects.

Captain J. E. Bernier, who was a guest of the Ontario Land Surveyors' Association, and who is going to try to reach the North Pole, addressed about 100 members and friends in the hall of the Engineers' Club, where the association were continuing their session, upon his plans for the voyage. Reference to Capt. Bernier's proposed voyage will be found elsewhere in this issue. The lecture which was illustrated by about 100 lime-light views, held the close attention of the audience for nearly two hours. J. W. Tyrrell, of Hamilton; James Dickson, of Fenelon Falls; Willis Chipman, and Hume B. Proudfoot, all spoke briefly in support of the following resolution, which was unanimously passed, favoring government assistance to Capt. Bernier's project:

"Whereas, The association of Ontario Land Surveyors has for many years, made a study of polar explorations; and the committee of the association on polar research engaged Lieut. Peary to lecture before the association in 1896 and in 1897, the association instructed this committee to attend Dr. Nansen's lecture, after his return from his 'Farthest North:' and the

expeditions of DeLong, Nansen, Abruzzi, and others, have established beyond doubt the theory of the constant and regular drift of polar ice from Behring Strait across the pole towards Iceland; and several members of the association have been engaged from time to time in exploring British America in the vicinity of the Arctic circle, and the association holds that all portions of British North America should be fully explored and mapped, and all of our northern heritage claimed; and the association has heard Capt. J. E. Bernier's lecture upon his projected voyage, and has heard his proposed equipment described; and they believe Capt. Bernier to be a suitable and capable person to command a polar expedition;

"Therefore, This association at its annual meeting, hereby fully endorses Capt. Bernier's proposed route to reach the vicinity of the North Pole via Behring Strait, thence northwesterly along the coast of Siberia until in longitude 170 deg. east, thence northerly as far as practicable into the pack ice, thence drifting across the Arctic Sea in the direction of Iceland to navigable water; and, believe Capt. Bernier, with proper support, will succeed in his undertaking; and the association would respectfully uge upon the Dominion Government, the desirability of bearing all expenses in connection with fitting out the expedition and equipping the same; and that a copy of this resolution be forwarded to the Premier of Canada."

A hearty vote of thanks was also passed to Capt. Bernier.

The third days' session, February 28th, opened with a report of the "Topographical Survey Committee," which had not come to hand, but was taken as read.

A paper by J. N. Wallace, of Hamilton, on "Topographic Photography," was read by H. H. Gibson, of Willowdale, Toronto, owing to the absence of the writer. The report will be summarized in our next issue.

A discussion on "Track Laying," introduced by John Stewart, of Montreal, proved very interesting; he describing a survey he made in the Rockies, B.C., as illustrating the difficulties of railroad surveying in that mountainous region; the matter being well thrashed out by Messrs. Tyrrell, Gibson, Walker, Van Nostrand, Stewart and others.

Chairman L. B. Stewart stated that the Exploration Committee on "Digest Northern Ontario Exploration," had not finished its report.

A discussion on the "Duties of Surveyors as Referees," between Messrs. Van Nostrand, McDowell, Kirkpatrick, Chipman, and others, which proved very interesting, closed the morning session.

Thursday afternoon the closing portion of the three days' session opened with the election of officers; Messrs. Esten and Whitson acting as scrutineers, the result being as follows:

President—James Dickson, Fenelon Falls.

Vice-President—W. R. Aylsworth, Belleville.

Secretary-Treasurer—Villiers Sankey, Toronto.

Members of Council—A. Locheed, Port Arthur; C. A. Jones, Petrolia; J. McAree, Rat Portage; C. J. Murphy, Toronto; J. W. Tyrrell, Hamilton.

Auditors—A. J. Van Nostrand and K. Gamble, Toronto.

On motion of J. Dickson, seconded by A. P. Walker, $225 was voted the secretary-treasurer for his year's services, the extra $25 being for unexpected disbursements.

On motion of J. W. Tyrrell, seconded by A. P. Walker, the committee on polar exploration was revived.

On motion of Willis Chipman, seconded by J. W. Tyrrell, it was decided to send a circular to each member informing them that it was Capt. Bernier's wish that one of their members should volunteer to accompany him in his search for the North Pole, under the auspices of the association.

The convention closed with a hearty vote of thanks to President Ross, and the singing of "God Save the King."

THE BANQUET.

The annual dinner was held on Wednesday evening, 27th February, at McConkey's. President George Ross occupied the chair, and filled the position admirably, and the guest of honor was Capt. Bernier. There were present among others: R. F. Stupart, representing the Canadian Institute; Kivas Tully, V. L. Hertzberg, president Engineers' Club, of Toronto; Capt. Whitla, G. B. Kirkpatrick, Fred C. Jarvis, Willis Chipman, Herbert J. Bowman, J. Hutcheon, M. J. Butler, W. R. Aylsworth, A. R. Davis, J. W. Tyrrell, James McDougall, A. J. Van Nostrand, J. F. Whitson, B. G. Leigh, R. McDowall, H. B. Proudfoot, R. W. Coulthard, P. F. Graham Bell, James Dickson, H. L. Esten, R. P. Fairbairn, W. B. Ford, and E. B. Biggar. The toast of the "King" was replied to by Mr. Aylsworth, and the "Empire" by Capt. Whitla, Messrs. Tully, Aylsworth and Biggar. In reply to "Our Guests," T. W. Gibson, of the Bureau of Mines, spoke pleasantly of the work of the surveyor, and G. B. Kirkpatrick referred to the work of exploration in Northern Ontario, recently carried out under the auspices of the provincial government. Among other results, the work of this exploration party disclosed the fact that there exist in one unbroken tract, 16,000,000 acres of arable land—an area large enough to make 700 townships—while spruce forests were surveyed which would yield 270,000,000 cords, and pine timber sufficient to make 3,000,000,000 feet of as good lumber as is to be found anywhere. In another tract there are 6,000,000 acres of agricultural land of exceptional quality, ready for the plow. This will add a new agricultural tract equal to all of the present settled part of Ontario, west of a line drawn from Niagara north to Midland. No account is here taken of the minerals to be found in the northern tract. He thought we were just entering on the greatest era of development Ontario had ever known; and before the first quarter of this century closes, that district will have a population of a million or two. This great country should not be given up to railway corporations. The provincial government were likely to build a road through there from North Bay, so as to connect westward with Clergue's system, and east to Missinobi. "Sister Societies" was replied to by A. L. Hertzberg, who referred to Capt. Nansen, as his countryman and acquaintance. He had every confidence in the plans of Capt. Bernier for reaching the pole. After Mr. Stupart and Mr. Jarvis had also replied, Mr. Dickson, the vice-chairman, made a neat speech, proposing the health of Capt. Bernier, whom he regarded as the right man in the right place. He hoped the Government would back Capt. Bernier in his expedition to the pole. Capt. Bernier, in returning thanks for the honor paid him, said he was not a scientific man, but a sailor; but if there was an open sea at the pole, he could sail there. He referred to the progress made in polar research, and said the day would come when places like Parry Islands would be summer resorts. Messrs. Bowman, Butler, Davis and Van Nostrand replied to various voluntary toasts. "The Ladies" were honored by Messrs. McDougall and Leigh, and "The Press," replied to by E. B. Biggar. Harry M. Bennett, R. McDowall and B. Leigh rendered songs that were much enjoyed.

Personal.

Randolph R. Crosby, Yarmouth, N.S., has been appointed by the C.P.R., superintendent engineer of its White Pass and Yukon fleet of steamboats.

A. P. Low, of the geological staff of the Dominion, has resigned to take a position in the Dominion steel works at Sydney, C.B., at $6,000 per year.

Harwood Frost, of the Frost & Wood Co., of Smith's Falls, will be in charge of that company's exhibit of machinery at the Glasgow exhibition, which is to open in May.

L. M. Rice, the well-known railway engineer, has taken charge of the Greenwood-Phoenix mines. Mr. Rice will have charge of the Greenwood and Phoenix tramway during the construction of the C. & W. railway; he was the engineer in charge of the most difficult parts of that most difficult road.

Charles Aird, manager of the Britannia branch of the Ottawa electric railway, formerly of the Cornwall street railway, died at his home in Britannia, February 17th, from cancer of the stomach. He was in his 51st year, and leaves a widow and one daughter. Deceased was for many years connected with street railways in Ottawa, Vancouver and Cornwall.

THE ARMSTRONG GANG PLANER TOOL.

The Armstrong gang planer tool is especially adapted for surfacing large castings, and on this class of work the claim is made that it will effect a saving of fifty to seventy-five per cent. in the time required to do the same job with a single point tool. As shown in Fig. 1 the head of the tool is solidly secured to the shank, on which it swivels to a limited degree, by means of a deep and closely fitted tongue and socket, and when set its position is fixed by means of two steel collar screws. The head is graduated thus enabling the tool to be quickly and accurately set to any desired feed. Both shank and head are drop forged steel, and all parts are hardened. The set screws are tool steel tempered on the point.

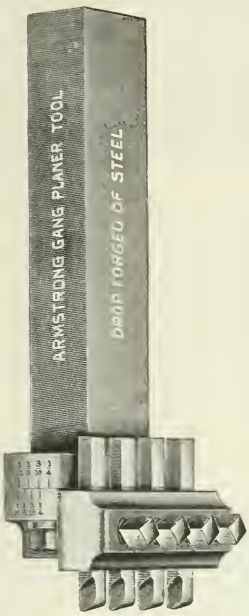


FIG 1.

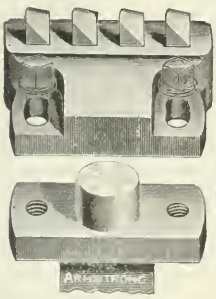


FIG. 1.

FIG. 3

Fig. 2 shows a cut taken with the No. 61 gang planer tool set to ¼-inch feed, distributing the cut 1-16 inch on each cutter. Each chip being comparatively light a planer with this tool will carry with ease a feed and depth of cut much greater than would be possible when using an ordinary tool, and there is moreover much less tendency to "break out" at the end of cut. The cutters are made from stock sizes and shapes of self-hardening steel, which are readily obtainable. In grinding cutters it is of course necessary to obtain uniformity of shape and clearance. To enable this to be done easily and accurately we furnish with each tool a gauge which will be found of great assistance in grinding cutters to proper shape to give best results. To line up cutters to uniform depth it is only necessary to let them rest on a flat surface while tightening set screws.

Fig. 3 illustrates the "cutter form gauge" referred to. One of the great obstacles to the successful operation of tools of this character has been that cutters are not ground to uniform shape, and it is believed this cutter form gauge will to a great extent do away with this trouble. This tool is made in three sizes, carrying four, five and six cutters. Prices and other information will be supplied by the makers, the Armstrong Bros. Tool Co., 106 West Washington street, Chicago, Ill.

CANADIAN RAILWAY STATISTICS.

The annual report of the Department of Railways and Canals just issued shows that the gross earnings of the Intercolonial Railway, the principal government road, for a year, amounted to $4,552,071, an increase of $813,704; and the working expenses to $4,431,404 (including $164,694.47 rent paid for the extension into Montreal) being an increase in comparison with previous year (when $210,000 was paid for such rental), of $755,718; the excess of earnings over expenditure being $120,667, against an excess of expenditure over earnings in the previous year of $62,645.23, or a betterment of $58,021. Comparing the earnings with those of the previous year, the passenger traffic produced $1,404,469, or 30.85 per cent. of the gross earnings, an increase of $237,006. The freight traffic amounted to $2,912,790, or 63.99 per cent of gross earnings, an increase of $564,693, and the carriage of mail and express freight produced $234,811.32, or 5.16 per cent. of the gross earnings, an increase of $12,029.62. Earnings, per mile of railway, were $3,462.52, an increase of $618.97. The gross earnings of all the Government roads, last fiscal year, amounted to $4,774,161, showing an increase of $828,344, compared with the preceding year. The gross working expenses amounted to $4,665,228, an increase of $758,615. The net profit on the operation of the year was $108,937. The Intercolonial gave a profit of $120,667; the Windsor branch a profit of $34,450, and Prince Edward Island a loss of $46,193. During the fiscal year, in addition to the sum of $1,459,000 paid to the Drummond county railway there was an addition of $1,769.34 to capital account expenditure, making total expenditure charged to capital on the whole road up to $60,341,425. The number of passengers carried on the Intercolonial was 1,791,754, an increase of 188,659 over the previous year. The freight increased by 400,447 tons.

There were 17,657 miles of railway operated in Canada last year, an increase of 417 miles over 1899. The number of passengers carried was 21,500,175, an increase over the previous year of 2,366,810. Other interesting figures are: Paid up capital $998,268,404, an increase of $33,568,620; gross earnings, $70,740,270, increase $8,496,486; net earnings, $23,040,472; increase, $1,502,805; working expenses, $47,699,798, increase, $6,993,581; freight carried, 35,046,183 tons, increase 4,734,430 tons; train mileage 55,177,871, increase 2,962,664; passengers killed, seven.

The total number of railways in actual operation in Canada, including the government roads, the Intercolonial and Prince Edward Island railways, at the end of the fiscal year (June 30, 1900), was 154, but some of these are either amalgamated or leased; making the number of controlling companies 86, not including the government lines; the number of companies absorbed by amalgamation is 36, and the number of leased lines is 33; the number of completed miles of railroad was 17,824, an increase of 466 miles, besides 2,558 miles of sidings. The number of miles laid with steel rails was 17,604, of which 501 miles was double track, the number of miles in operation was 17,657. The paid-up capital was $998,268,404, an increase of $33,568,620, and the gross earnings were $70,740,270; an increase of $8,496,486. Working expenses aggregated $47,600,708, an increase of $6,993,581 compared with those of the previous year, leaving the net earnings $23,040,472; an increase of $1,502,805. The number of passengers carried was 21,500,175, an increase of 2,366,810. The freight traffic was 35,046,183 tons, an increase of 4,734,430 tons. The total number of miles run by trains was 55,177,871, an increase of 2,962,664. The accident returns show 7 passengers killed. Out of the total increase in expenses, 4 roads, the Canadian Pacific, the Grand Trunk, the Canada Southern and the Intercolonial are responsible for over $5,700,000; while at the same time they gained over $6,700,000 out of the total increase in earnings.

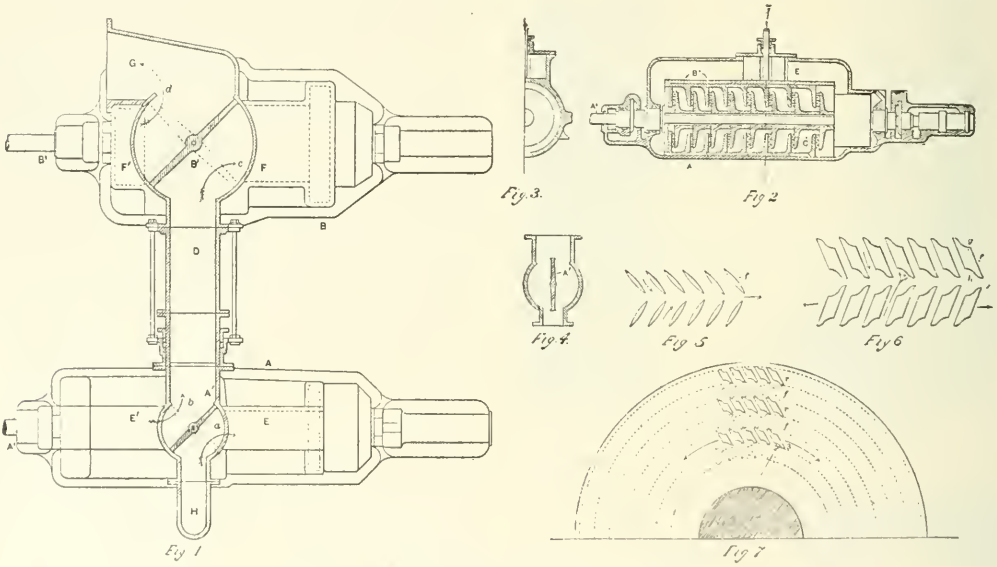
PARSONS' STEAM TURBINE REVERSING MECHANISM.

From letters patent granted to the Hon. Charles A. Parsons we get the following particulars of his new method of reversing his turbine: "In steam turbines as at present constructed certain difficulties are found in effectively reversing the direction of the rotation. In one method of reversing, already adopted by one of the present applicants, a special set of reversing jets and blades is applied to a marine steam turbine, and when it is desired to reverse the engine the steam supply is cut off from the main turbine and sent through the reversing blades or jets only. This device enables the turbine to be reversed; but the reversing power is not great, as it is impossible to use any great number or series of reversing turbines without increasing complexity and diminishing the efficiency of the turbine when running in its normal direction.

"The object of this invention is to overcome the difficulties and complexities of the ordinary method and to obtain a powerful reversal of a steam turbine without appreciable complication of its mechanical construction. The invention consists in an improved form of turbine blade, by the use of which a turbine can be run efficiently in both directions. In Figs. 1 and 2, A is the high-pressure turbine, and B the low-pressure A2 and B2 are the propeller shafts driven by the turbines. The high-pressure steam from the boiler is admitted to the turbine A by way of the pipe H, and for going ahead the steam passes on one side of the reversing valve A, which is of the butterfly type, to the end of the steam turbine by way of the passage E, as shown by the arrow *a*. The steam then passes through the various sets of moving and fixed turbine blades B4 and C4, Fig. 2, to the opposite end of the turbine, and thence it discharges to the passage E and passes on the other side of the reversing valve A, as shown by the arrow *b*, to the pipe D, communicating with the low pressure turbine B. The steam enters that turbine by one side of the reversing valve B and the passage F, as indicated by the arrow *c*, and discharges by the passage F and the other side of the reversing valve B to the exhaust pipe G, as indicated by the arrow *d*. When it is desired to reverse both turbines the reversing valves A B are placed in the position indicated in dotted lines in Fig. 1, and then the steam passes to the low pressure end of each turbine and discharges from each high pressure end. When one of the turbines is required to go ahead while the other reverses, one reversing valve is operated for that purpose. When it is desired to cut one turbine out of action the reversing valve of that turbine is moved to its middle position, as shown in Fig. 4.

Fig. 5 shows a series of fixed blades *f* and rotating blades *r* of ordinary construction. These blades are moderately curved and converge in the direction in which steam flows when the turbine is going ahead. When so rotating the steam passes between the fixed blades *f* in the direction of the arrow, impinges upon the concave sides of the rotating blades *r*, and discharges from them, continuing the direction of flow. The moving blades then rotate in the direction of the centre arrow. This form of the blade gives very good results when the steam passes as just described; but when the steam is caused to flow in the direction of the lower arrow, so as to reverse the motion of the turbine, it then impinges on the convex sides of the blades and travels in the direction in which the blades diverge. Under these conditions the efficiency is lowered considerably.

"In order to get turbines to work efficiently in both directions we construct the blades as shown in Figs. 6 and 7. Here the fixed blades *f* and the rotating blades *r* are made with flat parallel sides, which have concavities *g h*, one at each end of the blade, so that the steam, whichever way it flows, impinges on a concavity. When the steam flows as indicated by the lower arrow, the jet splits up when inpinging on the concave surfaces *g g*, and the turbine rotates as shown by the arrow 3. When the flow of steam is reversed to the direction shown by the upper arrow, the fluid then impinges on the concavities *h*, and the turbine rotates as shown by the arrow 4. By this construction the efficiency is equally good in both directions of running."—Engineering Times.



REVERSING MECHANISM OF PARSON'S STEAM TURBINE.

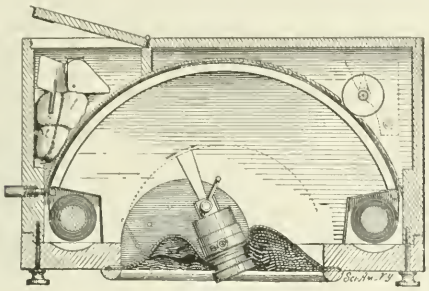
A CONVENIENT PANORAMIC CAMERA.

The amateur photographer, equipped with the ordinary 4 by 5 camera, many times sees, in the course of his excursions, opportunities for securing pictures embracing a wider range of view than his camera permits, and generally arranges the instrument to rotate in such a way as to take a succession of separate views, covering an area of 180 degrees; then, by joining the finished pictures in line together, a panoramic view is obtained. A picture of this kind requires a nicety of manipulation in matching to obtain satisfactory results, otherwise the joints will appear too prominent and render the scene imperfectly

Since the advent of the rollable film and the subsequent improvement known as a daylight cartridge film, different forms of cameras have been devised for making panoramic pictures. Our illustration is a type of one of the latest styles of a panoramic camera called the "Al-Vista" just introduced by the Multiscope and Film Company of Burlington, Wis., embracing several improvements which make it very con-

venient and adaptable for several purposes; at the same time it can be easily and rapidly operated, loaded and unloaded.

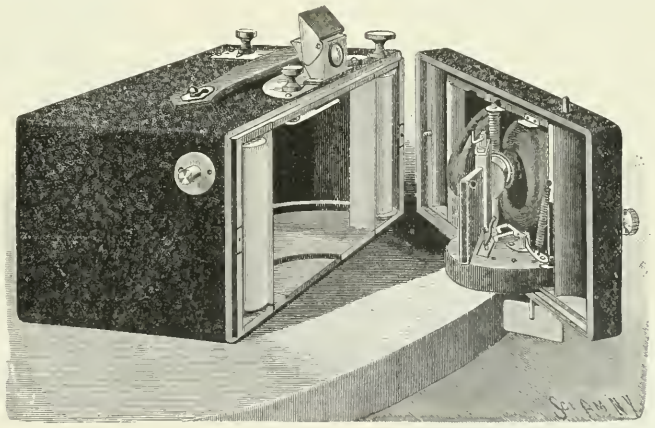
The camera is made in two principal parts; first, the lens board, or front, and lens-moving mechanism; and second, the back or box for holding the film, film spools, film punching and registering device, lens index, stop arm, finder and level. This construction enables the operator at will to take a picture of a uniform width of 4 inches to 4, 6, 8, 10 or 12 inches long. The lens supplants the ordinary focal plane shutter by itself, rotating over a half circle and throwing the image 4 inches wide by 12 inches long upon the semi-circular film in the rear. It is pivoted rigidly midway between the front and rear lenses to a vertical shaft operated by clockwork mechanism observed in a casing below the lens, and is protected by a flexible leather front. A flaring radial rectangular tube about 2 inches long projects rearward from the lens tube and carries the picture rays from the lens in the form of a narrow strip of light, something like the flash of a lighthouse lamp, continuously along the rear circular sensitized film. So it is only necessary to control the extent of the revolution of the lens to determine the length of the picture desired. To settle the lens, the key seen underneath is rotated, which in turn winds up the clock spring, and turns the lens in the opposite direction until it is held by the release lever. At the rear of the lense tube is a small shutter whose projecting arm at the top is arranged to impinge against the stop plate arm to be seen just under the centre of the top of the film box. This has an index pointer on the outside and can be quickly adjusted by rotating the knob with fingers. If an exposure 6 inches long is desired, the pointer is set at figure 6; when the lens is released, it rotates until the arm of the shutter strikes the stop arm and thus only exposes a 6-inch section of the whole film. The finder is supported upon a revolvable plate, also having an index pointer, and this is set at the figure 6 so that the image viewed in it will be parallel to that covered by the lens. Adjacent to the finder is a circular level. A shaft from the clock-work mechanism projects slightly through the bottom of the lens board, or front, and to this may be attached different sized flat pieces of metals, which act as fans and regulate the different speeds at which the lens can be made to rotate. There is also provision made for inserting different sized stops in the lens.



The sensitized film spool is put in the extensible spool holder on the left and carried over a guide roller and on through the semi circular channel to the other end, where it is wound up upon the winding spool, against a suitable tension plate. The thumb screw-head for operating this spool is seen on the right hand end. In its movement the film also operates an index cylinder, which tells at the top the number of inches of film reeled off, then on the left is a punch button for punching a hole through the film after each exposure, as a guide to the separation of the pictures.

The lens front is secured to the film box by two thumb screws, one at each end. Every part is accessible and the matter of friction in the free movement of the lens is reduced to a minimum. The camera is intended to be supported on a tripod, but is provided with a handle, and in emergencies can be held on the arm during exposures.

In an exposure without any fan attached, the lens rotates from one side to the other in 1½ seconds, causing the image to travel over a space of 12 inches, thereby giving 1-6 of a second stationary exposure. Fans lengthen the exposure, ¼, ½, ¾, ½ seconds, according to size used. In the rear is a compartment for holding the finder, fans, stops, etc. From what has been said it will be noted that the camera is a very useful instrument, in view of the fact that panoramic or smaller sized pictures, time or instantaneous, can be quickly and easily made, according to circumstances.—Scientific American.



PANORAMIC CAMERA.

Editor CANADIAN ENGINEER:

FRICTION IN WATER PIPES.

Sir,—We have read "The Instructiveness of Failure" in January number with profit and pleasure. But re the water supply for Quebec jail, we would like to know what use the 18 inch pipe was placed there for. Was it fed by the same source or head? How far from discharge end of 4-inch pipe was the connection made? How far from source or head is the roadway mentioned where it forced the water 60 or 70 feet high? As we really fail to see that the friction in that size pipe in that distance, with 130 feet of a head, would retard it to anything like such as is stated, we are as yet under the impression that there must be another cause or causes. A reply in Canadian Engineer will be looked for.

C. WILLIAMSON, Oshawa.

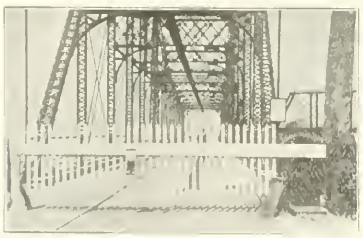
[We have referred this question to Chevalier Baillairge, the author of the article on "The Instructiveness of Failure" who replies as follows:—Ed.]

Answering Mr. Williamson's enquiries as to the friction in a 4-inch pipe, 1,800 feet in length having caused the supply of water to the reservoir in the attics of the Quebec jail to fall off to an extent to require a supplementary basement cistern to be introduced, whence the water had to be pumped to the cistern

in the attics for service to the building: The 4-inch pipe alluded to was laid in 1860, and at that time did deliver its water at the required height, some 60 feet above ground level of site on which the jail is built, but in course of time the supply fell off, due to the incrustation or tuberculosis formed in the interior of this 4 inch pipe, thus reducing it in 1887—a period of 23 years—to an efficient diameter of not much more than 3 inches, or by nearly 50 per cent. of its quondam efficiency, by which time the water merely trickled into the cisterns instead of flowing into them as when the pipe was new, clean and of double the effective area of section (16 to 9). The 18-inch main from Mount Pleasant, 251 feet above the St. Charles, was used for supplying the higher wards of the city, Montcalm and St. Louis, but was intended at first to take the water from Lorette, 486 feet above base to a reservoir situated on the heights, and it is because it was considered inadvisable to tap this pipe for a branch from it to the jail that the 4-inch rider was laid side by side with it all along the 1800 ft. reach of De Salaberry street. I send herewith copy of a report of mine of 1885 on the Quebec aqueduct. The tabular statement is replete with the most instructive data as to the retardation of the flow of water through long lengths of small bore pipe. This table has never been published as yet, and cannot but be extremely edifying to the profession, as it will be seen that both at the glove factory in Prince Edward street, and at the woolen factory in Jacques Cartier street, where a gauge or static pressure of 100 lbs., would have caused the water in an enclosed tube to ascend to nearly 234 feet in vertical height; yet, such was the drag caused by friction in pipes laid then more than 35 years ago, and tuberculosed to an average thickness of close upon one-half inch all around, that the open air jet at each of these points—the hydraulic test of the system—did not reach higher than 20 odd feet; that is, to the second story only of each of the buildings mentioned, or say only one-tenth of the height due to the static or gauge pressure of the locality. The fire pressure at these points, were since greatly enhanced by the introduction of some lines of pipe of double the diameter, or four times the capacity.

GATE FOR APPROACHES TO SWING BRIDGES.

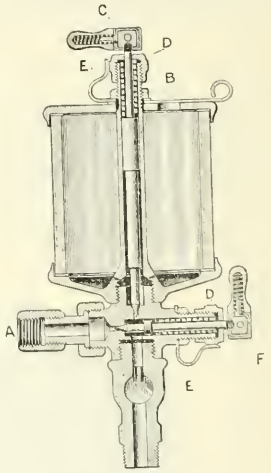
The gate here illustrated is patented by the N. L. Piper Railway Supply Co., of Toronto, and is operated from centre of bridge by the attendant who swings the bridge. The operator has absolute control of the traffic, as each gate, or pair of gates at the ends of the draw, is operated by separate levers. The gates are on the approach to bridge at either end, and being operated from centre of draw the connection necessarily requires to be broken each time the bridge is swung. This object is obtained by a very simple yet reliable clutch and



receiver, which releases the connection by a trip, and allows the rod to be drawn back clear. This operation lowers the gates, and the attendant has a clear bridge with all traffic blocked at either end. The next move is to swing the bridge. An automatic device—consisting of a straight lever, the tail of which is moved aside by closing the bridge, and is attached to rods and cranks leading to lock which is operated by a very powerful spring, and engages the projecting rod at end of gate the moment bridge starts to open—immediately locks the gates down, and they cannot be raised until the bridge is swung back to its proper position for traffic. This releases the lock and allows operator to raise the gates, which operation lock the bridge, as when the levers are thrown over, the rodding attached is forced into the receiver and clutch at either end, and act as two powerful bolts. The gates, as will be seen, block the entrance to the open draw, so that not even a child can get through. The illustration is of a set of gates which are in operation at the Burlington canal bridge, and have given perfect satisfaction for three seasons. Traffic over this bridge is very heavy, and being at the entrance to Hamilton harbor, on busy days is swung over one hundred times, which necessitates of course the raising and lowering of gates each time. That these gates have stood this test for three seasons speaks well for their utility, as there has not been an accident of any kind. Major Gray, chief engineer of the Public Works Department for the province of Ontario, says this is a unique device, and the mechanism which was specially constructed for the position by Hiram Piper is the only one he knows of.

NEW PRESSURE OIL CUP.

The pattern of pressure oil cup shown herewith contains a number of improvements over other forms of cups heretofore used on pressure oiling systems. In all other makes of cups the glass cylinder or reservoir must constantly be kept under pressure, and, in case of breakage of same, considerable oil is



lost and the cup is rendered useless. Another undesirable feature of the old style of construction is that, on account of the large diameter of the glass cylinder, if there is much pressure on the oil supply it is difficult to keep the joints from leaking. In the present form of cup the glass reservoir is not under any pressure whatever, but, instead, the oil supply is piped through the union A in base, the opening of which into the oil duct leading to the bearing is controlled by oil regulating valve F. The auxiliary supply is regulated by the oil valve C. The advantages of this construction in pressure oil cups are obvious in comparison made with other styles. With this improved cup it is easy to regulate the supply of oil under pressure, and, when it is desirable to cut off same, the valve F can be turned down and will act as an indicator, showing from a distance that the supply is shut off. The regulation of this valve is very simple and easily effected, and, when once set, is not disturbed by the jarring of the machinery. The feed can be turned on or off by simply raising or lowering the cam lever F. The sight-feed in the base is large, and the falling drops of oil can be seen plainly from a distance. The auxiliary oiler (which is intended to be used in case the pressure supply should be discontinued or cut off) consists of our standard pattern "Sentinel" oil cup, the feeding of oil being regulated by the cam lever C in the same manner as with the pressure supply. The auxiliary oiler has a large slide filler B, which dispenses with the screw plugs used in other patterns. All parts about this cup are made of cast—not spun—brass. It is a heavy, substantial, and durable device, simple in operation, and practical in its applications. In ordering extra glasses and cork washers, always specify name and size number of cup as stamped on same.

It is manufactured by the Lunkenheimer Co., Cincinnati, Ohio, U.S.A., and London, Eng.

Industrial Notes.

Jackson & Cochrane, of Berlin, Ont., are about to build a new foundry at a cost of $8,000.

Aurora, Ont., has carried a bonus bylaw for granting $10,000 to Underhill and Sisman to establish a shoe factory.

The population of Sydney, N.S., is now 15,000, and it is expected that 700 new houses will be built there this season.

The business of Warden, King & Son, iron founders and radiator manufacturers, Montreal, is being turned into a joint-stock company.

The Northern Iron Works is the name of a new concern which is commencing operations in Winnipeg as a foundry and machine shop.

The Polson Iron Works will furnish the engines and boilers for the Dominion steamers to be built on the Pacific coast for the fishery protective service.

The McCormack Co., manufacturers of agricultural implements and machinery, Chicago, are thinking seriously of establishing branch works in Canada.

A meeting of farmers has been held at Carlow, near Goderich, to organize a company to build a pork packing factory. The factory, if built, may be located at Goderich.

On February 12th the ratepayers of Lake Megantic voted on a bylaw to borrow $36,000 for waterworks and sewers, which resulted in its defeat by a majority of 49 votes.

The Metal Shingle & Siding Co., of Preston, Ont., are making additions to their works this season. The company are getting out many attractive new designs for interior decorative purposes.

At the Dominion Bridge Works, Lachine, Que., the "Camel" Brand Hair Belting, for which W. A. Fleming & Co., Montreal, are sole agents, is in general use throughout the several shops, driving all kinds of machinery.

Operations have begun at Collingwood on the erection of the docks and railway terminals for the use of the Cramp Steel Company, which is to build iron and steel works on a very extensive scale at the foot of Georgian Bay.

The Henry Stanyon Manufacturing Company, of Pittsburg, Pa., proposes to establish a branch at Collingwood, Ont., to manufacture wire, etc. The firm will employ 300 hands, and will erect a foundry and machine shop of large proportions.

The double 36-inch leather belt which started up the Shawinigan Water and Power Co.'s works, was supplied by D. K. McLaren, Montreal, who is importer of the English oak tanned strap butts, of the quality called for by this company.

The council of the association of Architects of the Province of Quebec has admitted to practice Pierre Levesque, Quebec, and H. C. Stone and S. Smith, Montreal. J. J. T. Donnelly, E. P. Raymond and C. A. Lemay, Quebec, have passed their preliminary examinations.

The Dominion Government is being asked for an appropriation of $40,000 in aid of the construction of an interprovincial bridge between Fort Coulogne, Que., and Gore Point, Ont. The Quebec and Ontario Governments will also be asked to contribute $20,000 each.

The recently proposed consolidation of the stove interests in one syndicate, with headquarters at Hamilton, has been definitely declared off. The McClary Mnfg. Co., of London, Ont., who withdrew from the negotiations, is applying to increase its capital to $3,000,000.

At the annual meeting of the Ontario Association of Architects the following officers were elected: Grant Helliwell, president; F. S Baker, 1st vice-president; John A. Pearson, 2nd vice-president; W. A. Langton, treasurer; William R. Gregg, librarian; C. H. Bishop and Charles Gemmell, auditors.

A number of Hamilton men have organized a stock company to build two centrifugal railways for the Pan-American Exposition, to be known as "loop the loops," one to be on the show grounds and the other at the Falls. The railway is intended to afford a flying trip through the air for three-quarters of a mile, in which the occupants of the cars will be turned upside down with care, the speed being so great that the cars, though upside down, will not leave the track owing to centrifugal force. The promoters are: H. G. Wright, Adam Zimmerman, W. Langhorn, R. B. Harris, J. M. Harris, O. G Carscallen, E. B. Wingate, Thomas Crooks, James Crooks and ex-Mayor Teetzel.

J. D. Ogilvy, St. Henri, Montreal; P. H. A. Caron, Petit Metis; J. P. Michaud, Fraserville, and P. A. Parent, St. Ulric, will apply for incorporation to buy or sell out patents for peat fuel; to acquire peat pits and logs; to buy, lease or acquire, build, erect and operate mills for the manufacturing of combustible turf. Headquarters at Fraserville, Que. Capital stock, $100,000.

A very ingenious device called the "Dodge Calculator" has just been issued by Dodge Manufacturing Co., 74 York street, Toronto. This device is not only a novelty, but is also an instrument of considerable value and assistance to all mechanics, foremen, superintendents, etc., whose duty it is to figure the speed of pulleys, gears, etc. The calculator is a good illustration of the many uses to which the slide rule principle may be applied. The Dodge Manufacturing Co. will be pleased to mail a copy free for the asking.

The McEachren Heating & Ventilating Co., Galt, Ont., has a number of interesting orders on its books at present. One from Siemon & Bros., manufacturers of tables, Wiarton, calls for a complete factory equipment, dry kiln, heating apparatus, and shaving fan system for carrying away shavings, dust, etc. Newlands & Co. have given the firm an order for a 90-inch steel plate steam fan, with direct attached high speed vertical engine; thus doing away with the smoke stack. The company claims this to be a great economizer of fuel. The E. B. Eddy Co., of Hull, has placed a similar order with the firm. Several months ago the McEachren Heating and Ventilating Co. got out patterns for a line of high-speed vertical engines, of all sizes, and report having had success in this line which surpasses their expectations at the time of entering upon it.

George Janin, C.E., the new superintendent of the Montreal waterworks, who is also general manager of the sewage farm established under contract with the city for the disposal of the sewage of St. Denis Ward, is delighted with the success of this winter's experiment, it being predicted by many that the operation of such a farm would be impossible in such a severe climate. Mr Janin says that, with the steady cold weather of this winter the farm has had as severe a test as it is ever likely to receive, and the sewer outlet and filtration beds have never once been blocked by the snow or frost. Three filtration beds have been used this winter, and three hours after the sewage was distributed over the snow-covered, frozen surfaces of the beds the percolation was complete. Mr. Janin thinks that steps should be taken to dispose of most of the city's sewage by means of similar farms, instead of discharging it into the river. He expects to raise heavy crops of coarse vegetables on the farm during the coming summer.—Witness.

Railway Matters.

The South Shore Railway is to be finally sold this month. The courts will not grant any further postponements.

F. W. Jones, formerly assistant to the traffic manager of the Canadian Pacific, western division, has been appointed operating manager of the Canadian Northern Ry., with headquarters at Winnipeg.

A rumor has been current in railway circles to the effect that the Minister of Railways contemplates extending the I.C.R. west to the Great Lakes, and to form a connection with the Canadian Northern for the trade of the Northwest.

The C.P.R. has begun the construction of an important branch line in British Columbia, which will open up the entire Sloean district, the new line is about 60 miles long running from Lardo at the head of the Kootenay Lake, by way of Duncan and Trout Lake, to Arrowhead, the terminus of the Revelstoke branch of the C.P.R.; work has been started at both ends (Lardo and Arrowhead), and will be ready next season.

The United States House Committee on Railways and Canals has authorized the Lake Erie and Ohio River Ship Canal Company to construct a canal from Pittsburgh to the nearest harbor on Lake Erie, with all the branch canals required.

Fitzpatrick, Roy and Cannon, of Quebec, are applying for a charter to build a railway from Lime Ridge in Wolfe county to the site of the proposed Quebec bridge over the St. Lawrence by way of the Thames River with power to enter the city of Quebec.

The following officers of the Canadian Locomotive Company, Ltd., of Kingston, were elected at a meeting held in Toronto, February 13th: President, Hon. Wm. Harty; vice-president, M. J. Haney, Toronto; managing director, C. Bermingham, of Pittsburgh, Pa.; secretary, J. J. Harty, Kingston; treasurer, J. H. Birkett, Kingston, and superintendent, H. Tandy, Kingston.

The Battleford-Fish Creek and Lake Lenore Ry. Co., are applying for a charter for a railway from Battle River in Saskatchewan near the confluence of Cut Knife Creek and Battle River, thence east by way of Battleford and Fish Creek to Lake Lenore, and on to the Canadian Northern near Crooked River; also to build a branch from Fish Creek to Qu'Appelle Station. Lake Lenore lies amongst the hills northeasterly from Saskatoon.

The Canadian Pacific Railway will this year expend the following sums on improvements: Between Vaudreuil and Perth, $25,000 for ballasting a distance of 61 miles; water tank and stand pipe at Kemptville Junction and Monklands; enlarged sidings at twelve points between Toronto and London, $9,000; repairs to bridges west of Toronto, $37,000; ballasting west of Toronto, 36 miles, $19,000; stand pipes at London, ballasting on Owen Sound division, $10,000; sidings on Owen Sound division, $8,000; acetylene gas lighting plant at Owen Sound; electric light plants for lighting freight sheds, engine house, etc., at Toronto, and also at Toronto Junction, $12,000.

A new paint, containing no asphaltum, and capable of standing a high degree of heat and imparting to iron or steel a hard, smooth, glossy surface, has been on trial for one year on the Boston and Maine Railroad, and it has proved so valuable and economical, that they now order it in ten barrel lots. Every railroad in New England is now using this paint. The custom heretofore, has been to go over the dull parts of locomotive boilers with a composition of oil and lampblack; a daily application being necessary when the engine is in service. One application per month of the Hot Iron Paint is said to be ample. The selling agents of this paint are Fuller & Kitfield, No. 2 Kilby street, Boston, Mass. We understand the firm will send a sample free.

The Canadian Pacific engineers are surveying the route for a new line in British Columbia from the coast eastward, which they have power to build under a charter granted in 1875, from Abbotsford, via Chilliwack to the line of the Columbia and Western Ry. The construction of this line would block the construction of the Victoria, Vancouver and Eastern Ry., which is being now surveyed. The following branch lines will be constructed, and are now either surveyed or being surveyed. From Lardo to Selkirk in British Columbia, 33 miles; from Trout Lake to Ferguson in British Columbia, 5 miles; from Midway to Pretoria in British Columbia, 88 miles; from Okanagan Falls to Spence's Bridge, 191 miles. This company during the year ending December 31st last constructed nine different branch lines, aggregating 130 miles of line, and has now under contruction a tenth branch from West Selkirk to Lake Winnipeg, 26 miles.

A deputation is asking the Ontario Premier for aid for the Manitoulin and Northern Railroad. C. F. Farwell, member for Algoma, introducing the deputation, said that the road had already twelve miles constructed west from Sudbury. It would run south to Little Current, and then cross over to Manitoulin Island. After extending across the island a ferry would be taken across the Georgian Bay to the Bruce Peninsula, a distance of twenty miles, where the line would be continued on to Wiarton, Meaford and Owen Sound, making Toronto 75 miles nearer Winnipeg and the Soo. The road would not only open up the entire nickel belt, but give the mines a lake port at Little Current, where cheap coke could be landed by water freight. The Premier was averse to making a grant of land. The road already had a subsidy provided for the distance from Sudbury to Little Current. He thought that the company ought to go ahead and do something before they were given land.

The following railway companies are applying to the Dominion Parliament for an extension of the time to finish their works: The Hudson Bay and Pacific Ry., O. E. Culbert, solicitor, Ottawa. The Atlantic and Lake Superior Ry., J. R. Thibaudeau, Montreal, president. Irondale, Bancroft & Ottawa Ry.; Arrowhead and Kootenay Ry. Co., Robertson and Robertson, Victoria, B.C., solicitors. Mather Bridge Co. want an extension of five years for building a bridge over the Niagara River. Vancouver, Westminster, Northern and Yukon Ry. Co., extension of time and extension of territory and lengthening line. Columbia and Kootenay Ry. and Nav. Co., G. O. M. Dockrill, solicitor, New Westminster. British Columbia Southern, extension of time and permission to build branches. Columbia and Western, extension of time to build branches, and to revise its bonding powers. South Shore Ry., extension of time and the ratification of its title to the Montreal and Sorel Ry., the Great Eastern Ry, and part of the Montreal and Atlantic Railway.

The C.P.R. have adopted the Hall automatic block system of signals at their Windsor street terminals in Montreal, making train accidents between Windsor street and Montreal Junction, utterly impossible. The rails are electrically connected, and each track between these points is divided into a definite number of sections, at the end of which the current is communicated to a signal staff, which works automatically, the first train reaching the junction getting the right of way going east; if the track is clear a white disk in the daytime, and a white light at night, is shown on all the signal staffs at the end of each section; but if there is a train ahead in the next section a red danger light is shown on the signal of the section in which the following train is running. If the train ahead is clear of the first forward section, but in the second ahead a green caution light or disk is shown, telling the driver that their is a train in the section 2 ahead of him, and that he must run carefully. In this way there is always one clear section between trains, going either way; so that unless drivers run past signals a meeting of trains on the same track is impossible; and if a rail is shifted or there is an impediment on the track, all the signals fly to danger. The automatic signals are said to be so much more reliable that there is not a single switch or signal man on the terminal tracks between Windsor station and Montreal Junction

Marine News.

Ten regular lines of steamers will run to Port Arthur this summer.

The proposed amalgamation of the Brockville Navigation Company and the Rockport Navigation Company has fallen through.

Owen Ritchie, of Ottawa, is seeking incorporation for the King Edward Ship Building Corporation of Canada, to build, own, and sell ships, etc.

The Jones & Moore Electric Co. are installing two direct connected electric light plants on the dredges "I.X.L." and "Sir Hector" at Morrisburg, Ont.

The Toronto and Montreal Steamboat Co. have placed an order with the Jones & Moore Electric Co. for two electric search lights to be placed on their steamers "Persia" and "Ocean."

Capt. J. W. Troup, late commodore of the Canadian Pacific Navigation Co., and manager of one of the Kootenay branch lines, has been appointed the new manager of the coast steamship service of the Canadian Pacific Ry.

The annual meeting of the Rainy River Navigation Co., Ltd., was held at Rat Portage, on the 6th February. Although the past season was very unfavorable so far as low water was concerned, the earnings of the company were satisfactory. The directors for the ensuing year are: Geo. A. Graham, president, John Bertram, Toronto; Cornelius Neilson, treasurer, of Erie county, Sandusky, Ohio, and Walter Ross and Clifford Lewis, of Rat Portage. G. C. Frisbie is secretary-treasurer.

The annual meeting of the Northern Navigation Co. was held in Collingwood on January 29th. Officers were elected as follows: James Scott, president; J. J. Long, vice-president; T. Long, secretary, and C. E. Stephens, treasurer; Wm. Askin, manager.

H. H. Gildersleeve, general manager of the Lake Ontario and Bay of Quinte Navigation Company, has leased the steamer "Caspian," of the R. & O. Navigation Company, to run in conjunction with the steamer "North King," between Rochester and Gananoque.

The tonnage of freight passing through the Canadian canals during the season of 1900 was: Welland, 719,360; St. Lawrence, 1,017,990; Chambly, 348,561; Ottawa, 302,782; Murray, 18,916; Trent Valley, 43,065; Soo, 2,035,677. The returns for the Rideau and St. Peter's canals are not yet at hand.

The Lakeside Navigation Company's officers for 1901 will be the same as last year. Captain N. J. Wigle will again command the "Lakeside," and Captain D. Enright will have charge of the "Lincoln." Engineers Flummerfelt and Horwood will again be with the company.

Thos Nihan has sold the steamer "Garden City" to the Niagara, St. Catharines and Toronto Ry. Co., to run between Toronto and Port Dalhousie this summer in Pan-American traffic. The old crew will be re-engaged. The company are buying another steamer in the States for the same traffic.

The officers of the Niagara Navigation Company's fleet for the season of 1901 will be as follows: "Chippewa," Capt. J. McGiffen; chief engineer, G. Arnold; second, J. Findlay. "Corona," Capt. H. Loames; chief engineer, Wm. Walsh; second, M. Carroll. "Chicora," Capt. R. Clapp; chief engineer, H. Parker.

On the 1st inst. the city council of Halifax passed a resolution bonusing the establishment of a steel shipbuilding plant in Halifax to the extent of $100,000, and an additional sum not exceeding $100,000 on the completion of machinery and boiler shops turning out not less than 20,000 tons of steam shipping annually.

The Montreal Harbor Commissioners, with their chief engineer, are visiting the Straits of Mackinaw to inspect the ice-breaking boats which are used in the neck of water lying between Lakes Huron and Michigan each winter. The information gained will be applied to the problem of ice-breaking on the St. Lawrence.

While O. P. St. John, hon. president of the Marine Engineers' Association, was inspecting a boiler in the London Electric Light Co.'s station last month, he met with a painful accident. In coming out of the manhole of the boiler he missed his footing and fell a distance of 12 feet, receiving a cut on the head which required 20 stitches, and had three ribs broken.

The government at Ottawa have made a contract with the Polson Iron Works, Toronto, to build a large hydraulic dredge, with all the latest improvements, for use in dredging the channel through Lake St. Peter. It is to cost $250,000, and is said to be the largest machine of the kind in North America. It will be of steel. The dimensions are: 160 feet long, 40 feet beam and 12½ feet deep, of the barge type. The pump will have a 36-inch suction pipe, and be driven by 1,200-h.p. triple expansion engines.

The keel of the new palace passenger steamer, now building in Toronto, for the Richelieu and Ontario Navigation Company, has been laid. The steamer when completed will cost between $450,000 to $475,000, and promises to be the finest passenger steamboat on the continent. The boat is like the "Kingston" and "Toronto." She will be 340 feet long, over all. The "Kingston" is 290 feet long. The new vessel will be 60 per cent. larger in accommodation throughout than the "Kingston."

The Collingwood Bulletin has the following marine items: The Playfair's Wrecking Co.'s tug, "Metamora," is being thoroughly overhauled. Capt. H. Cleland has sold his tug, "Maggie May," to Parry Sound parties. The dry dock and ship yards are now a hive of industry; a portion of the keel of the new steamer is laid and some sections of the centre keelson placed. The Shipbuilding Co. have the contract for a wooden steamer and a steel tug, besides smaller jobs. Capt. W. Bemrose will again sail the steamer "Pittsburg."

Electric Flashes.

The number of incandescent electric lights to be used at the Pan-American fair is estimated at 500,000.

The Jones & Moore Electric Co. have installed a 15-station private telephone system for Nerlich & Co., of Toronto.

A bylaw for the purchase of the electric light plant at Paris, Ont., was carried by a majority of 130 votes, on February 14th. The price to be paid is $15,000.

E. A. Macdonald, ex-mayor of Toronto, states that his scheme for developing electric power from the Humber, near Toronto, is being taken up by Philadelphia parties.

Two United States capitalists are negotiating for the purchase of the Brantford Street Railway Company's lines, plant and franchise with a view of extending it to Paris.

The directors of the Niagara, St. Catharines and Toronto Ry. made their first trip over the Port Dalhousie electric line on the 26th ult. The site of the new dock at the port was inspected.

The Kingston Gas and Electric Light Company has named $373,000 as the price it would accept for its plants. The council think this too high, and the case will go to arbitration under the Conmee Act.

The Victoria Foundry Co., Ottawa, have installed two more motors of the Jones & Moore Electric Co.'s manufacture, making a total of 80-h.p. in motor capacity which they have purchased from this firm.

John Sykes, N. Ainley, A. Sykes, H. Holdroyd and J. Hutchinson, all of Georgetown, are applying for a charter under the act for the Georgetown, Ont., Electric Light and Power Co.; capital stock, $40,000.

J. W. McRae, late managing director of the Ottawa Electric company is applying for a charter from the government, also a franchise from the city, for the Consumers' Electric Power Co., of Ottawa for generating light, heat and power.

The Montreal Street Ry. will have ready by the end of May, 25 new double truck open cars, with 13 seats, holding 65 people seated. Mr. Wanklyn, the general manager, says they will have 320 of these new cars ready for the coming summer's work; and that besides preparing for 5,000-h.p. from Chambly, they will have two new steam engines of 1,500-h.p. each.

The Jones & Moore Electric Co. have recently received orders for electric motors from the Minerva Manufacturing Co., Ambrose Kent & Co., J. Seddon, D. L. Thompson, Canada Featherbone Co., the R. Simpson Co., and the T. Eaton Co., all of Toronto; G. W. Green, Peterboro; Cordova Exploration Co., Cordova; Jas. Hope, Ottawa; J. W. Greer, Peterboro; also several machines to their Vancouver and Winnipeg agents.

—The executive committee of the Canadian Electrical Association has fixed the dates of the next annual convention at Ottawa for the 19th, 20th and 21st of June. A committee has been appointed to arrange for papers and topics for discussion. A strong local committee has also been nominated to make local arrangements for the meeting, which gives promise of being a most successful one. A number of new members were elected at last executive meeting.

The electric power and light generating establishments in the city of St. Catharines, Ont., are being consolidated, which will ultimately place them in the control of the Cataract Power Co., of Hamilton; a short time ago John Knox, of Hamilton, representing the Lincoln Light and Power Co., a newly organized corporation, purchased Wm. Cook's electric power and lighting plant in St. Catharines. The Lincoln Light and Power Co. is a branch of the Cataract Power Co., of which Mr. Knox is a prominent member. It is now stated that Thomas Nihan, a large property and vessel owner, and who virtually controls the St. Catharines Electric Light and Power Co., will turn it over to the Lincoln Light and Power Co., who will then have charge of both concerns; they are also after the Packard Electric Co.'s factory, and the immense water power from the Welland Canal controlled by them, all of which will become branch companies under the control of the Cataract Power Co.

The Ballard Electric and Machine Co. report that the demand for their telephone equipment is constantly increasing. The following are recent installations that testify to the quality of the firm's work: Copp Clark & Co., Hart & Riddel, P. W. Ellis Co., Can. Gen. Electric Co., M. Staunton & Co., Bertram ship yards, Gillispie, Ansley Co., Gutta Percha Rubber Co., Irving Umbrella Co., J. Young (undertaker), all of Toronto; the Ontario Agricultural College, Guelph, and the Bank of Commerce, Collingwood.

F. L. Wanklyn, general manager of the Montreal Street Railway, and also chairman of the board of construction of the West India Electric Company has returned from Kingston, Jamaica, and reports that the company has 23 miles of track in operation, and that the system is in excellent condition; besides the line through Kingston, there are branches six miles north, six miles east and six miles northeast, the cars are open and operated by colored men. The ties are all steel, and the company are operating about 25 cars. Ross Kerr, formerly of Ottawa, is manager.

The annual meeting of the Bell Telephone Company was held in Montreal on the 28th ult. The annual report shows that the total number of sets of instruments now earning rental is 38,360, there having been 3,437 subscribers added during the year. The company owns and operates 343 exchanges and 494 agencies; 2,430 miles of wire have been added to the long-distance system in 1900. The long-distance lines now owned and operated by the company comprise 21,350 miles of wire on 6,525 miles of poles. The receipts for the year were $1,614,262; expenditures, $1,229,977, leaving net revenue, $384,285, from which $371,304 was paid in dividends. The entire capital stock having now been issued, and funds for construction being required, the shareholders at a special meeting held December 5, 1900, authorized application to Parliament for power to increase the capital from $5,000,000 to $10,000,000, and the petition will be presented in due course. At the same meeting the directors were authorized to issue $2,550,000 of bonds. In reference to the public's use of the telephone the president said that from carefully prepared reports covering all parts of the Dominion it was found that each instrument was used on an average of nine times each day. The average period elapsing between the time the subscriber rang the central until he had the desired communication was eleven seconds. After a careful investigation of the different telephone systems of the world, he had come to the conclusion that Canada had the very best. The following directors were elected for the ensuing year: C. F. Sise, president; Robert Mackay, vice-president, and Alex. Cochrane, Robert Archer, Hugh Paton, Charles Cassils, W. R. Driver and Thomas Sherwin.

The Canadian General Electric Co. held its annual meeting recently, and their report showed net profits to be $262,903, and premium on new stock, $75,000; these items and the balance of $58,437, from last year, make $396,340. Of this sum, $127,623 has been absorbed in paying a 10 per cent. dividend on common, and 6 per cent. on preferred stocks; $125,000 has been added to the reserve, which is now $265,000, and $12,601 was placed to the credit of profit and loss; W. R. Brock was re-elected president; H. P. Dwight, 1st vice president, and Frederick Nichols, 2nd vice-president and general manager.

The annual report of the Lachine Rapids Hydraulic and Land Co. for the past year has been issued. The report mentions that during the past year, the following improvements have been made. The wing dam has been raised above flood level, for a distance of about 3,300 feet, finishing at the stone ice-breaker. It is constructed with the embankment of material taken from the tail race. This has a double object: First, to do away with the overflow of the dam, thereby decreasing the current at the intake, and saving the timber dam from being damaged by ice, and at the same time providing a deep channel in the tail race for winter use, and causing all the water used by the wheels to be discharged on the shore side. A dyke on the shore side, from the power house west, has been constructed to protect the low lands from being flooded in high water. During the year there have been installed ten 250 k.w. air-blast transformers complete with blowers. The net increase of incandescent lamps, added to the circuits during the year was equivalent to 15,376 16-c.p. lamps, making a total of 71,500 lamps connected in addition to 205 arc lights on flat rate. The power in motors, connected to the circuits during the year, amounted to 1,548 h.p.

The Crow's Nest Pass Coal Company, Ltd., is increasing its total capital stock from $2,000,000 to $3,500,000.

The Argentine Peat Syndicate, Ltd., has been incorporated; head office, Guelph; to deal in peat, peat fuel, peat gas, moss, etc.; capital, $60,000.

The Smart-Eby Machine Co. have recently installed a set of Rogers' patent shaking and dumping grate bars in the Aged Women's Home, Hamilton; and one in the London, Ont., Printing and Lithographing Co.

The shipments of coal from the Maritime Provinces last year were 3,025,000 tons, an increase of 375,000 tons over 1899. Of the various collieries those of the Dominion Coal Co. had the largest output, 1,834,680 tons, an increase in this case of 281,124 tons over 1899.

The Golden Crown Co. have been making mining tests during the past summer on the Stewart river, in the Yukon district, by means of dredges similar to those in use in New Zealand; next season they propose to do so on a larger scale, with a more expensive dredging outfit.

The present capacity of the Granby Smelter Co.'s works in British Columbia is 1,200 tons per day, but a despatch from Rossland says: Orders are soon to be placed in Chicago and Milwaukee for new furnaces and a converter to turn matte into metallic copper at the Granby smelters, in Grand Forks. This will double its output, raising it to 2,400 tons daily, and give it a refinery fitted to extract gold and silver values, and turn out the copper as metal.

A COMPETENT BOOK-KEEPER wishes situation as accountant, or for general electrical work. Address, **R.H.**, c/o Canadian Engineer.

WANTED—A Mechanical Draughtsman. One accustomed to general machine design preferred. Address D. B., care of Canadian Engineer, Montreal, P. Q

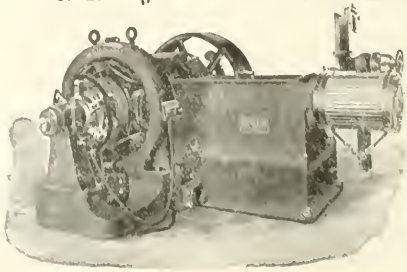
Alex. Bremner
IMPORTER
DRAIN PIPES
CEMENTS
FIRE BRICKS
MORTAR STAINS, etc., etc.

50 Bleury Street, MONTREAL

Incorporated 1861
Hamilton Powder Co.
Manufacturers of
EXPLOSIVES
And Dominion Agents for
Blasting Appliances of all kinds
OFFICE:
103 St. Francois Xavier St., MONTREAL
Magazines and Branch Offices at the Chief Distributing Points in Canada

The Electrical Construction Co. of London, Limited

Manufacturers of **High Grade Electrical Machinery, Multipolar and Bipolar Motors and Generators**, all sizes to suit any voltage. Special designs and slow speed Motors manufactured at reasonable rates—with guaranteed results. Direct Connected and Belted Isolated Lighting Plants a specialty. Commutators refilled, switchboard & switches always in stock and to order.



Office & Factory: 66 YORK ST., LONDON, CANADA.

The Canadian Engineer

VOL. VIII.—No. 12. TORONTO AND MONTREAL, APRIL, 1901. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, 1392. Montreal Telephone, 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

SEE PAGE 264 FOR CONTENTS.

CONSTRUCTION OF THE SHAWINIGAN WATER AND POWER CO.'S PLANT.

The St. Maurice river is a stream draining 18,000 square miles of heavily timbered country on the north side of the St. Lawrence river, into which it empties at the city of Three Rivers, situated about half way between Quebec and Montreal, the distance to either of these cities being 90 miles. About 15 miles back from the St. Lawrence, this river, in breaking through the Laurentian hills, forms in a distance of 15 miles a number of falls and rapids, which with the heavy flow of water obtainable, are capable of development into power at a very low capital cost. A minimum of 200,000 h.p can be developed here at the lowest known water, even after allowing a liberal proportion of the flow for the carrying away of frazile or anchor ice during the winter. As the low water in this region unfortunately occurs in the winter, some allowance of this kind has to be made. Owing to the lack of railroad communication, these desirable properties have lain fallow, but the opening of the Great Northern Railway of Canada, which will give the best of them direct communication with Quebec, Montreal and Ottawa, and thus open them to the world, has made their commercial development feasible. The city of Three Rivers is open to ocean navigation for eight months in the year, and it is not improbable that at no other seaport in the world is there a power of such magnitude within a radius of thirty miles. A portion of this power has already been developed at Grand Mere, distant thirty miles from Three Rivers, where it is utilized under a head of forty feet in the operation of a pulp and paper mill, having a capacity of 100 tons of paper and 50 tons of pulp daily.

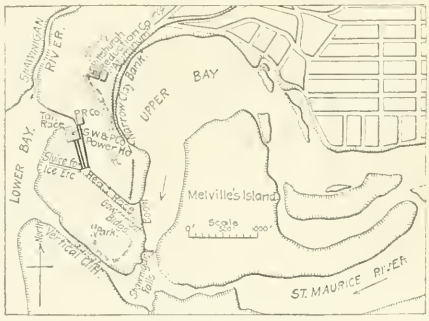
The most important power location, however, is that of Shawinigan Falls, a cascade having a fall of 140 feet in a very short distance. The normal flow of the river at this point is 24,000 cubic feet per second, and 80,000 h.p. can be developed and utilized at the very lowest water. The Shawinigan Water and Power Company has acquired the whole of this power from the government, and is developing it on a large scale. It has acquired large tracts of land in the vicinity, built a standard gauge branch, four and one-half miles long, through rough country to the Great Northern Railway, with sidings, turntable and terminal facilities, and has been working throughout the past two years on an initial development of 30,000 horse-power with a headrace and intake of sufficient capacity for extension to 60,000 horse-power. A town site has been laid out, and its improvements projected, and the population now numbers over 4,500.

The natural conformation of the ground in the vicinity of the Falls is somewhat remarkable. A narrow ridge or hogback of clay formation extends out as a peninsula separating two bays of the river forming the upper and lower levels of the falls, between which

Aspect Before Commencing Operations—Valley of Little Shawinigan River.

there is a drop of 140 feet. A small stream called the Shawinigan river, falling into the lower bay, carries this peninsula still further back, making it nearly a mile in length, with a width from 600 to 1,000 feet. This ridge, along which the railway is carried, was originally only five or six feet wide on top in places, falling away with slopes of one and one-half to one on each side, and although formed of nothing but blue clay has withstood the pressure of water coming within 20 feet of the crest at high water, the distance through the section of the ridge from water to air being not over 60 feet. Borings taken for a depth of 80 feet below water during the past winter show nothing but blue clay. This bank was, however, being carried away slowly by erosion, and must at some future date have broken through. After building the railway along the ridge the bank has been thoroughly rip-rapped with loose stone from the excavation in the head-race, thus obviating all danger of this kind.

Toward the upper corner of the bay, the water is of considerable depth, affording facilities for the development of an independent water power for a paper mill or other large industry. At the end of the bay toward the Falls the water is shallow, with large sand bars which would render any development at that end exceedingly expensive and troublesome to maintain.



Plan of Upper and Lower Bays.

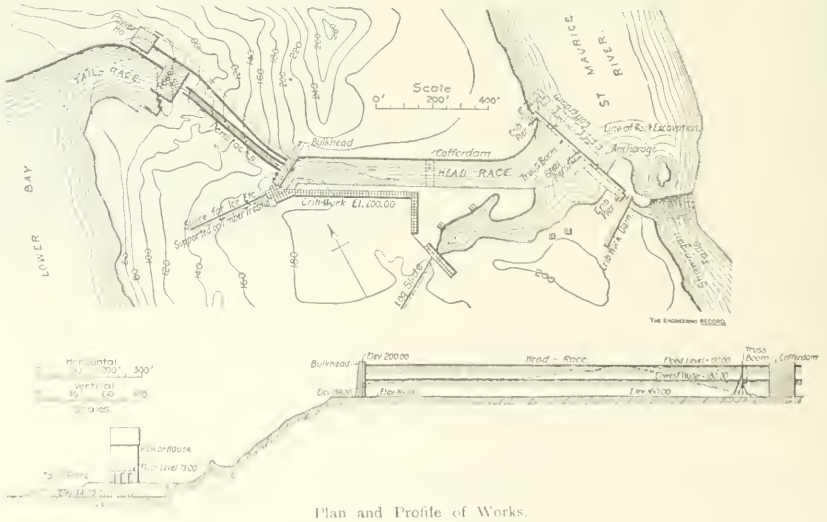
Just above the Falls the river is divided, by a large island, into two channels, both of which converge half way down the Falls. The united waters strike directly into the face of a rock cliff and turn at an angle of about 110 degrees to their course, forcing their way through a narrow gorge, in which there is a drop of 25 feet, into the lower bay.

The present development consists of an intake canal or head-race about 1,200 feet long, cut through the rock from a point just at the head of the Falls and running back at an angle of 135 degrees with the course of the river, with a glance boom to deflect floating natural ground is high, and by a timber cribwork wing dam on the left-hand side. The dry wall is built of heavy stone with vertical stepped back, the face being battered two inches to a foot. This wall is from six to twenty feet high, and is filled in behind with loose stone and gravel so as to form a road along the bank of the head-race.

The cribwork dam, 15 feet and 20 feet wide, and from 10 to 23 feet high, is built of 12 x 12 inch pine face timbers, laid two inches apart, with 10-inch round pine cross-ties 10 feet apart in each course and staggered in alternate courses so as to form 5-foot pockets and with 6-in. flattened longitudinal stringers running through the centre. This dam is faced with two layers of dressed pine plank, 2-in. thick. Both the face timbers and sheetings are closely scribed to the rock, and the dovetailing of the ties into the face timbers and general fitting is of a superior character. The crib is filled with stone very closely packed and is backed with stone for about half its height. A talus of gravel is to be laid along the outstream side extending over to the edge of the excavation. All bolting was done with ⅞-in. round spikes driven into ¾-in. holes, bored by a pneumatic boring machine.

At the end of this crib, next the bulkhead, is placed an ice chute to carry off drift ice and trash from the racks, and the crib being 40-ft. high at this point, is 30-ft. wide. Cribwork was used along this side of the canal, so as to be easily removed when the canal is widened and the bulkhead extended for additional penstocks required to develop 60,000 horse-power.

The entrance to the head-race is protected by a heavy glance boom in two sections, each 220-ft. long,



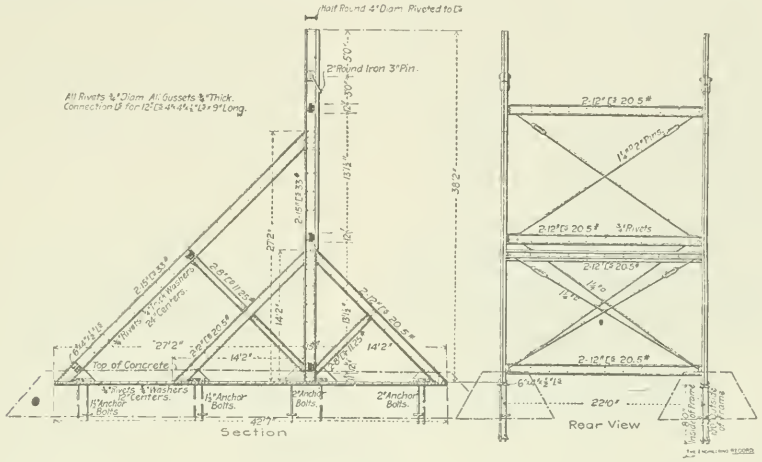
Plan and Profile of Works.

debris and ice over the Falls, terminating with a heavy masonry bulkhead from which the water is carried in large steel penstocks to the power-house below.

This canal is funnel shaped for about 500 feet of its length at the entrance and beyond this has a width of 100 feet by a depth sufficient to give 20 feet of water at the lowest known level of the river.

The sides are formed by the natural rock, above which they are carried up to a height of 40 feet by a dry stone wall, on the right hand side, on which the supported by two heavy crib piers at the ends and by a steel structure in the centre. The cribwork piers are 30 x 30 feet square, by 26 feet high, and are built of 12 x 12-in. pine face timbers, laid to 2-in. spaces, with 6-in. flattened cross-ties 10-ft. apart in each course, staggered in alternate courses. They are faced with 6-in. oak on the outstream and upstream sides, and each of them has two elm mooring posts 20-in. in diameter, capped with cast iron. The bottom timbers are bolted down with 24 fox-bolts, 1¼-in. in diameter running 5-ft. into the rock.

The steel boom pier consists of a bent of two vertical posts, each made of a pair of 15-in. channels 38-ft. 2-in. long. These uprights are 22-ft. apart in the line of the boom, and are braced with horizontal and diagonal struts, and sway bracing in every direction, particularly, of course, in the direction of pressure at right angles to the line of the boom, the connections being made with gusset plates riveted between the webs of the channels. The bases of the bents are each formed by two pairs of angles set upon concrete piers. These bases are anchored down with 1½-in. fox-bolts, 10-ft. long, running 6-ft. into the rock, and having a cross-piece to set into the concrete base piers. Half-round rubbing pieces are provided to allow the boom to slide smoothly up and down, and heavy shackles are provided to which the boom chains will be secured.



Steel Pier for Boom.

The boom is made in the form of a Howe truss, there being two sections each 220-ft. long, 4-ft. deep and 10-ft. wide. The face timbers are three courses of 12 x 12-in. timbers with 3-in. plank laid solid between diagonally, forming the main bracing, the counter-bracing being formed by 4 x 12-in. timbers on edge spiked to the main bracing. The truss is divided into 10-ft. panels and bolted with iron bolts 1¼-in. to 1¾-in. in diameter with plate washers. On the outstream side the boom is faced with 3-in. tamarack plank laid longitudinally to take up the wear of the ice, etc.

Heavy ring bolts are provided for securing the boom to the mooring posts. The main anchorage for the boom, however, will be 1½-in. steel chains secured to heavy ring bolts bedded in concrete in the river bottom. These are placed so that the boom will engage the boom piers at all heights of water, and have a tendency to keep toward the piers. The chains secured from the ring bolts to the piers give double safety against the possibility of losing the boom.

The bulkhead is built of what may be called concrete rubble. The bottom under the bulkhead is solid rock, and on this was first laid a footing of 1:2:5 concrete, extending 25-ft. in front of the bulkhead. On this the steel rack framing, gate slides, pipes, etc., were set up, and concrete bulkhead then placed. This is 32-ft. wide on the bottom by 15-ft. wide on the top, and the masonry is composed of heavy blocks of stone laid with at least 12-in. of concrete between them, composed of 1 part cement, 2 parts sand, and 5 parts of fine broken stone. All stone was kept back 12 in. from the face of the bulkhead, and any stone showing a face of over 4 sq. ft. kept back 18-in. from the face. A smooth face in concrete was formed by laying 3-in. of 3 to 1 cement mortar against the forms, holding it in position by a light steel plate, then laying up concrete and drawing the plate, ramming the whole lightly together after the heavy ramming of concrete was completed.

The penstocks were carried through the bulkhead in slightly conical shape, being 9-ft. 6-in. in diameter at the mouth by 8-ft. 6-in. where they project from concrete. There are six of these large penstocks, each of 5,000 horse-power capacity, and one of 3-ft. 6-in. diameter for the exciter wheels.

The danger of collapse from atmospheric pressure through sudden shutting of the gates and the withdrawal of water from the pipes, is provided against by having five vertical air pipes 12-in. in diameter, extending up from the mouth of the pipes to the top of the bulkhead behind the gates. Two cut-off rings are placed on the outside of pipe to set in the concrete.

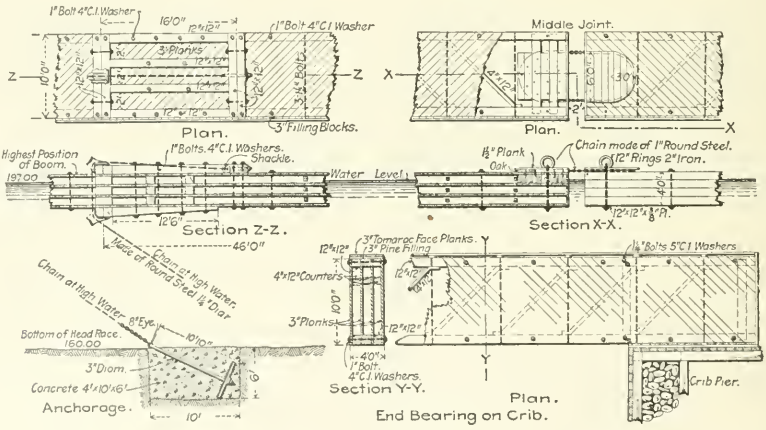
The gates are 10-ft. high by 10½-ft. wide, and are built of ⅜-in. plates on a framework of 10-in. I-beams, and slide on steel vertical strips bearing on T-bars riveted to channels bedded in the concrete. They are to be raised by hydraulic pressure, by pumps on bulkhead operated by motors controlled from the power-house below. The pressure used is 750 lbs. per square inch. Each gate has a single shaft connected to two rods running through the whole height of gate, and is so made that on commencing to raise the gate a section 12-in. high separates from the balance of the gate, and allows the penstock to fill with water, after which the whole gate is lifted together. The pneumatic pistons are designed, however, to open and close the gates under the total possible pressure due to a head of 40-ft.

The gate for the exciter pipe is of the same design but on a smaller scale.

In addition to the gates, the penstock entrances are protected by stop logs formed by 12-in. channel slides, into which 12 x 12-in. timbers can be dropped in case of emergency.

The rack framing is formed of trestles of I-beam set on oak stringers bedded in concrete in the bottom. Three lines of 15-in. I-beams, running horizontally, support the rack, which is laid on a batter of 3½-ft. in height of 28-ft., and is formed of 3 x ¼-in. bars, spaced at 2-in. centres with thimbles between, in sections three feet long. These sections are separated and are supported on cast iron blocks, bolted to the oak sill, of such a design that the section can be removed and replaced without the services of a diver. The sections are secured at the top against overturning by a hasp engaging in a staple spiked to the flooring of the rack platform. This platform is set 10-ft. below the top of the bulkhead at a height where the rack can be raked conveniently for a greater part of the year.

Another narrow platform is set level with the top of the bulkhead. The ice chute, previously mentioned, forms a convenient means of disposing of all trash raked from racks, which can be worked along the racks and into the chute. A light glance boom will be placed in the headrace leading to the ice chute, so that no floating debris will come against the racks. The height of water flowing through the ice chute will be regulated by stop logs at the entrance.



Details of Trussed Boom.

Three of the large penstocks, two of them 500-ft. long, and one 650-ft. long, are now in position. They will be lap-jointed on both longitudinal and girth seams at upper end, and lap-jointed on the girth seams, and butt-strap jointed on longitudinal seams at lower end. The plates are 5-16-in. in thickness at the upper end, and 7-16-in. at the lower end. The pipes will be supported on steel saddles 15-ft. apart, riveted to the pipe and resting on concrete base piers. These saddles are built of steel channels and angles, the angles on which the pipe rests being curved to fit the pipe. The bases of the saddles will be held down with 1-in. fox-bolts, running through the piers into the solid rock. The saddles are designed to receive bolting and framing of wooden housing for the pipe. This housing is necessitated by the extreme cold, and will also obviate trouble through expansion and contraction due to the changes of temperature. Anchor rods secured to angle connections on the pipe and to fox-bolts in the rock counteract the tendency to slide down hill.

Two of these pipes run to the main power-house of the company, where they will each operate horizontal double turbine units of 5,000 horse-power, with single generator units of the same capacity. The electric apparatus will be supplied by the Westinghouse Electric & Manufacturing Company, and the turbines by the I. P. Morris Co., Philadelphia. This arrangement is more fully described at the end of this article.

The power-house foundations are of massive concrete. The walls will be built of brick, with piers to support steel roof trusses and track beams carrying an electric traveling crane of 50 tons' capacity.

The third pipe will be used by the Pittsburgh Reduction Company in a separate power-house, discharging into the main tail-race. Two double turbine units of 2,500 horse-power with direct current generator on each end of 1,250 horse-power will be installed in its power-house, which will have masonry foundations with brick walls, and steel framing for roof and traveling crane.

This company's factory buildings are situated on a level of 160-ft. above, and 500-ft. distant from its power-house. The first buildings consist of one building 277 x 47-ft., one building 174 x 61-ft., and one building 196 x 81-ft., all of brick with stone foundations and steel framing. They also have two side-tracks into their property from the main line along the ridge. A second pipe of 5,000 horse-power is being held in reserve for this company. Their buildings and plant were designed by their own engineer, E. S. Fickes, of Pittsburgh, Pa.

General surveys for the present development were conducted under circumstances of great hardships during the winters of 1897 and 1898, and during the summer of 1899 other extensive surveys were carried out, including those for an electric railway to Three Rivers, and the location for the branch to the Great Northern Railway. The contract for the railway branch and work on the first development, including excavation, cribwork and masonry, was awarded on May 15th, 1899, to the Warren-Burnham Company of New York.

On May 23rd, 1899, work was commenced by opening up a wagon road two and one-half miles long into the Falls. Previous to the opening of this road, the only communication with the site of the works was by row boats. The work on the railroad, four and one-half miles of standard gauge, single track, involving the handling of 125,000 cubic yards of clay, was carried

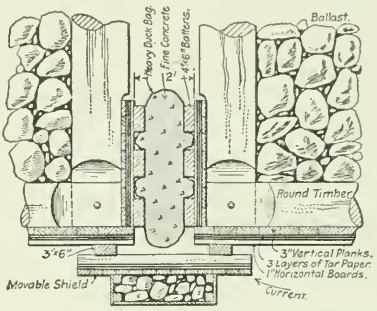
out, with the exception of the ballasting, in six weeks with a force of 1,100 men. Work on the excavation in the head-race and the tail-race was commenced about August 1st, 1899, and was continued until completion in June, 1900, with the exception of about two weeks lost through an abnormal flood in October, 1899.

The head-race excavation was taken out by 12 guyed derricks, 55-ft. booms, six on each side of the cut, set about 120-ft. apart. These derricks, together with spoil tracks, were set on top of the bank about 40-ft. above the finished bottom of the cut. The spoil was carried away in dump cars of about 1 cubic yard average capacity, one train running to a spoil bank on the left-hand side of the head-race, and the other (with a change of engines half-way out), running out and depositing rock along the railway embankment, along the upper bay to protect it from wash. This embankment is from 30 to 50-ft. high above the water. All spoil tracks were double alongside the cut, so as to provide for empty trains without interfering with the loaded ones. Considerable of the material was used for filling cribs, or building dry wall, or laid aside for use in masonry.

The rock is Laurentian granite or gneiss, without any regular bed, full of seams and very hard and difficult to drill.

On this work most of the derricks had the swinging gear attachment, and the superiority of this arrangement for work of this kind was made very evident. About 600-ft. of the straight section was excavated in the dry. For the balance at the intake a temporary coffer-dam had to be constructed. This was commenced about September 15th, after the logs had passed down the river, and was placed in six weeks' working time, being delayed about one month by the flood before mentioned.

This coffer-dam is 640-ft. on the water line by an extreme height of 30-ft., and was placed, without accident of any kind, in a current running from three to five miles per hour. It was placed 15-ft. away from the limit of excavation, and extends right over to the top of the Falls. The sand and gravel five or six feet deep in water, was first removed by means of a 6-in. centrifugal pump, set on a scow with separate boiler and engine, and discharging into midstream. This sand and gravel was thoroughly cleaned off, so as to allow the cribs to set on the solid rock. The dam was built of 12 cribs set about two feet apart end to end. In the deep water, these cribs were 23-ft. wide, 40-ft. long, and 30-ft. high. A raft or floating template, consisting of a rectangular platform, extending around the four sides of the crib was moored over the exact location of each crib successively, as the sand was pumped out, and from its outer edges pole soundings were made 2-ft. apart, and an accurate profile of the bottom obtained. The cribs were then started on shore, the lower courses and planking being accurately scribed to fit the bottom. The cribs were built of 12-in. round timber, notched on both sides at the ends, so as to lock together and give a clearance of about six inches between the courses. They were each built with three longitudinal and four transverse rows of cross-ties, forming six rectangular ballast pockets, with a rough ballast floor. The outside face of the timbers in the crib were adze-dressed to receive a sheathing of 3-in. square-edged dressed plank, spiked on with wire spikes. This sheathing extends four feet around the corners of the cribs. Over this was laid three thicknesses of tarred roofing paper swabbed with hot pitch, and protected by a layer of 1-in. boards, the joints of which were filled with pitch. This sheathing has been found absolutely water-tight. The first eight or ten courses of the crib were built on ways on the shore, then launched and floated into position, where the remaining courses were added, and the cribs sunk by rock ballast. A diver then placed bags of concrete into the cracks and irregularities of the rock surface, under the edge of the cribs, and then laid one course of bags along the tow. These were ordinary cement bags about half filled with one to two cement mortar, in which some fine broken stone was mixed. A bank of puddled clay 4-ft. high was then laid on top of the bags along the tow of the dam. The clay was deposited



Joint Between Coffer-dam Cribs.

through a wooden chute, and rammed. The joints between the cribs were made with vertical canvas bags 5-ft. wide and 30-ft. long. These bags were sunk and rammed full of concrete, being forced into the spaces between vertical battens spiked to the sides of the cribs.

To cut off the current through the openings, due to the water being lower on the inside than on the outside of the cribs, stop-gates were run down on the outside of the openings between the cribs. These gates were about 4-ft. wide and 30-ft. long. They were made of two layers of 2-in. plank, with tarred felt between, and laid against vertical bearing strips on each crib. A ballast box on the outside of the gate was filled with stone and the gate sunk into position when the pressure of water made it bear tightly. The bolting on this coffer-dam was done with ⅞-in. round spikes driven into ¾-in. round holes. The boring for these was done by a Standard Pneumatic Company's boring machine, driven by a Westinghouse standard air-brake compressor. This machine can bore a ¾-in. hole 24 inches deep through hemlock in less than a minute, and with it one man can do as much as eight men with ordinary augers. The coffer-dam proved so tight that the head-race behind was easily kept dry by one 8-in. centrifugal pump working at about half speed. After the work of excavation was completed, the rock filling was removed from the cribs, and the timber taken off or allowed to go over the falls so as to leave no obstruction whatever at the entrance to the head-race.

(Concluded in next number.)

—The special commission appointed by the British Government to investigate the record of the Belleville water tube boiler, as used in the navy, have gathered

such a mass of evidence as will doom that type of marine boiler. The wonder is that this doom has been so long delayed; for the bursting of tubes and the scalding and wounding of engineers and firemen have marked the history of this boiler since its introduction. These accidents have been concealed as far as possible, but the royal commission has fully exposed the dangers of this man-killer, which will soon be thrown out of every ship in the navy.

—Of the fitness of Dr. Adams to succeed the late Dr. George M. Dawson, in the Geological Survey, we are quite convinced; and there is no one we should more like to see in the position. We cannot, however, imagine anything more calculated to defeat the wishes of Dr. Adams' true friends in this respect than the resolution brought up at the annual meeting of the Canadian Mining Institute, last month, practically dictating to the government whom it shall appoint. If anything would be calculated to stultify the strong claims of Dr. Adams, it would be just such an ill-advised resolution. If government appointments are to be made upon the dictation of societies, there will be little sense of either self-respect or responsibility left to the administrative heads of the country.

—A very good idea, worked out by some of the large machine shops and factories in the United States and England, is the establishment of libraries for the use of the men. Some of these establishments have libraries of several thousand volumes of mechanical and general literature, and the plan works very well, especially in places where there is no public library, or in parts of cities where public libraries are not easy of access. Some of these libraries are formed largely by contributions from the employees, and some are largely, or wholly, the gift of the proprietors. The Canadian Engineer will be glad to give a contribution to the first of such workmen's libraries started in Canada. Who will be first to report?

ENGINEERING ETHICS.

Editor Canadian Engineer:

Sir,—In your report of the proceedings of the Canadian Society of Civil Engineers at the last annual meeting, which appeared in your February number, considerable space was given to the views advanced by members on four questions submitted by the writer for discussion, but unfortunately these questions were omitted from your report. That your readers may also have before them these questions, I enclose herewith a copy of same, which I trust you may find space for in your next issue.

It will be observed from the discussion, that while none defended "lobbying," many believe that engineers holding government positions, city engineers, and professors of colleges, should not refuse any professional work that may be offered them. I hold that any such engineer is morally bound to serve the government, the city or the college that employs him, and that he should not engage in active practice as designing engineer or engineer in charge of construction. It will be noticed that I expressed the opinion that engineers of the above classes might be properly engaged in consultation by other engineers. Some of the members in discussing this matter evaded the point at issue, assumed that I had stated to the contrary, and proceeded to argue accordingly

As to the employment of American engineers in municipal and public works, my views were certainly misinterpreted by some members. In certain departments of engineering, the American engineer may be better qualified or he may have had a broader experience than members of the Canadian Society. In the development of our natural sources and in the construction of works of magnitude they may very properly be retained as consulting engineers, but I hold that they should not be employed directly by our Dominion or Provincial Governments, or by our cities and towns as designing and constructing engineers. If the employment of American engineers be encouraged, then Canadian engineers will be of necessity forced to adopt American methods to a more or less extent, thus tending to degrade our profession to a trade.

There is no consistency in denouncing "lobbying," and the giving of engineering advice free if members of the society, and particularly those who now hold lucrative positions remain blind to the principal causes of such practices.

Toronto, Feb. 23rd, 1901. Willis Chipman.

The following is the statement referred to by Mr. Chipman, suggesting amendments to the code of professional ethics:

Within the last few years a "Code of Engineering Ethics," has been added to the bylaws of the society that now requires revision. The provisions of the present code may be applicable to the staff of engineers engaged by the larger railway companies, city engineers and government engineers, with their chief engineers, departmental engineers, division engineers, assistants, etc., but the code is no guide to a large percentage of the membership of the society, comprising electrical engineers, waterworks engineers, sanitary engineers, mining engineers, chemical engineers, etc., engaged in making reports upon and preparing estimates for proposed works; superintending construction, testing and examining existing works, etc., all of which works have multiplied rapidly of late years. I propose to submit a few pertinent questions for discussion:

1. Should engineers in private practise, canvas and lobby for professional engagement? I have always held that he should not, but I find that I am being laughed at by engineers, contractors, town councillors, and other officials. In nearly every issue of engineering periodicals will be found such items as this: "The town of has introduced a bylaw to raise by debentures $50,000, for a system of waterworks. For further information address A. B., Chairman of W.W. Committee," or this, "The town of has appointed a committee to engage an engineer to report upon the cost of an electric light plant, etc. For further information, address C. D., Town Clerk."

I believe an engineer is justified in writing a letter of enquiry, enclosing his professional card and references in response to such news items, but he should go no further. There are engineers, however, who visit the town, canvass the town council and prominent citizens, propose "deals" with members of council, and cut prices to half what the work is worth in their scramble for professional glory. The foregoing is not a fancy sketch, but can be substantiated, and the engineers who do this class of work are members of this Canadian society. From time to time I find an engineer who gives professional advice free, with estimates and sketch plans, that may be worth hundreds of dollars, on the chance of his generosity being appreciated later on by a town council then with an empty treasury. Are these engineers recent graduates of McGill or other engineering colleges? By no means. Two years ago a prominent member of the American Soc., C.E., an ex-city engineer, visited more than one place in Ontario, giving professional advice, where works were proposed. At one place the town council justified its action by stating that this American engineer stopped in town a day or so at his own expense, and not even upon the invitation of the town authorities. He was driven about by the committee having the work in charge, addressed a public meeting, and gave a written report with estimates of cost. Another engineer with head office in New York, a member of our society, can also be proven guilty of more heinous offences against the profession. It is possible that these men conduct their business in a professional way when in their own country, reserving half civilized Canada for exploits of the above character, but there are strong reasons for presuming that American engineers believe that engineering should be conducted as a business, that the engineer is justified in canvassing for orders and in exerting his personal influence on the ground; that an expenditure of public money is a job, and that he is entitled to all he can get out of it. I will confess that I was greatly shocked when I found an American engineer of such prominence acting, as I thought so unprofessionally, knowing that it must tend to degrade the profession

in Canada. This matter should have been brought to the notice of the society before this, but at the annual meeting last year there was scant time for routine business.

2. Should city engineers, government engineers, and other salaried engineers engage in private practice? The councils of the smaller cities and towns frequently deputize some member of the council to interview the engineer of some larger city, respecting some engineering project, waterworks, sewerage works, pavements, etc., and the city officials are only too willing in many instances to give the professional advice and information asked for, upon the chance of obtaining sooner or later a professional fee. This may have been justifiable when the city engineers were the only engineers with sufficient experience to advise on such matters, but there is now no excuse for it. Government engineers on public works are also often applied to by municipalities for engineering services that should be rendered by the local land surveyors or the engineer in private practise, because they can be secured for less money or in exchange for a "pull."

3. Should professors of engineering in our colleges engage in private practise? Our engineering colleges are now fully equipped for making scientific examinations and practical tests of building and structural materials, of machinery, of electrical apparatus, of explosives, etc., and all such scientific work should be referred to them. In no other way can the practising engineer obtain results as accurate or as impartial. There should be a sufficient amount of this class of scientific work to keep our professors engaged during such portions of the summer months that they do not require for holidays, and I submit that it is unprofessional for a professor in a school of engineering to compete with the graduates in private practise. If his salary be not sufficient, he should retire, open an office in the regular way and stand on an equal footing with other engineers. An engineer in private practise, who is also a professor, has an unfair advantage in that the college may be his office, and the plans prepared in the draughting rooms by the students. The professor also has a great advantage over his rival in the matter of advertising. It might be possible for a professor to conduct his private practise as a strictly separate business from his professorship, but is so improbable that he would be suspected of worse acts than those specified. I am proud to say that in the city of Toronto, the principal of the School of Practical Science has set an example that might be followed by others with credit.

4. Should the employment of American engineers on public and municipal works be encouraged? I have given you an example of the up to date American method of securing engineering employment. There are many places in Canada where these methods have succeeded, and in one town, the Canadian engineer, who designed the works was thus lobbied out of the engineership when construction proceeded, by an American engineer associated with a member of this society. Many Canadian engineers are now becoming experts in this American method of securing business, and consider it quite the proper way. The morals of our towns have in many instances been corrupted by American engineers and franchise hunters, and it would, in my opinion, be in the interests of our country and of the profession, if they were plainly told that when wanted they would be called for. It is quite proper that qualified engineers in foreign countries should be admitted as members to our society, in order to obtain the proceedings, etc. It is justifiable for members of our society to call in foreign engineers in consultation, if men of sufficient experience cannot be found in our society; but is it patriotic, is it right, that a foreign engineer should be permitted to conduct a private practise in Canada with a branch office not far from the rooms of this Canadian society, and a head office in New York or Boston? If he desires to become a Canadian and practise his profession, he will be warmly welcomed, but to form a partnership with a college professor, join our society, and use it as a means of extending his business into Canada with the introduction of "American Methods" and what must follow it, is quite a different matter and a very serious one. Unless the society and the individual members discourage in every way the employment of American engineers, especially by municipalities, our efforts towards elevating the moral standing of the profession, will amount to naught, and we will be forced to admit that our attempts to promote legislation favoring a close corporation have been premature, as it could then be pointed out that Canadian engineers were not competent to design municipal engineering works for the cities and towns of our country.

In conclusion, I desire to have recorded upon the minutes of this meeting an expression of opinion as to whether I am right or wrong on the points raised. If right, then a solution strongly setting forth the views of the majority should be placed on record, and the members should not only live up to the spirit of the resolution in their practise, but do everything in their power to expose any infraction of it. If I be wrong, then I and many other engineers must in future readjust our methods of business, and do as others have been doing in the past, and are doing to-day.

Editor CANADIAN ENGINEER:

Sir,—I have read your account of proceedings at the annual meeting of the Canadian Society of Civil Engineers with much interest. While reference is made to my letter on "Engineering Ethics," published in your December issue, no statement made in that letter has been successfully refuted. The discussion tends to show the necessity that existed for calling attention to the subject; though I would not consider the final judgment of the society, as now constituted, as determining the right or the wrong of the matter. That the subject is handled by the society mainly from a civil surveyor's point of view is only a further illustration of the growing need in Canada of a better representation of other branches. From this standpoint we can only look upon the retiring president's reference to the work of Stephenson and others, as a stealing of the other fellow's thunder. According to a letter on this subject from the secretary of the society, he says: "It (the society), claims to attach to the term Civil Engineering its original meaning in which all engineers are included 'military only excepted.' He refers to the Institute of Civil Engineers as containing "a large number of men engaged in mechanical work called engineering." The proposal to change the name of the society he says, "has been very keenly discussed." As most of your readers like myself know nothing of this discussion I propose with your consent to advance a few ideas as follows, in way of an open reply:

Yes, the society I know attaches to civil engineering its original meaning, that is to say, it follows in engineering ethics the precepts of years ago, and so refuses to accommodate itself in this respect to the more advanced conditions of the present age. At the time referred to there was probably no question, to-day I note with pleasure there is "keen discussion," some day action will result therefrom, and the car of progress will move on.

In older times as men emerged from the darkness of semi-barbarism, an art called engineering was evolved, which later on was divided into two classes: Civil and Military; but do these primitive divisions satisfy the present demands? The first man was called Adam, and lived to be so called for 900 years; but there are many more names than Adam to-day. As we progress in the paths of a higher civilization we organize, and classify; we subdivide and specialize, and "the society" might as well attempt to stop a thunderbolt in its path as to hold the course of evolution in this respect.

What is meant by members of Institute C. E., engaged only in mechanical work called engineering? I have it from the secretary himself, when visiting the rooms in London, Eng., that mechanical achievements and proficiency "cut no ice" in qualification for membership. Is the sentiment underlying this expression, that which would hold the mechanical engineer down to the level of his mechanics?—still he has at least acquired a name, since according to this expression there is a something mechanical that is "called" engineering, for this small recognition at the society's hands may mechanical engineers be truly thankful. Still the world in many ways bears testimony to the existence and ever growing importance of mechanical engineering of men who originate in mechanical art; whose power holds sway on the battle field, who feed the hungry and clothe the naked of our day; so with other branches of the profession, who enlighten our darkness also in many ways, to whom the old time designation is now only an ancient name; or if you like better, that of a mother grown old—though respected still her usefulness has departed and it is the hands of her children that now push the car of progress on

That all has not gone smoothly with the parent societies in other countries is evident by the formation of independent societies, representing all the other branches. Canada, I had hoped, might have taken a lesson in this respect, but after feeling the pulse of our present institution I have given that idea up as utterly hopeless—not only so but contrary to precedence and science. We are born, we grow, we reach the zenith of our fame, we fade, we wither, we die protesting, and by the hands of those who follow after are laid to rest amongst the venerable antiquities of the past.

Toronto, 28th Feb., 1901. ROBT. W. KING.

P.S.—Since writing the above my attention has been called to the existence of a society lately formed, under the title of the Dominion Institute of Amalgamated Engineers. It seems it has been started by members of the Canadian Society of Civil Engineers dissatisfied with the present policy of that society. The new title certainly seems more in accord with the requirements of our country, and its claimed objects entitle it to universal consideration amongst the full membership of the profession it embraces. The formation of this society to supply a want the parent society refuses to recognize, as also to act as a check on a class whose actions may not be to the best interest of the profession as a whole, is quite in accord with progress and my evolution theories. R. W. K.

CALORIMETER TRIALS FOR MOISTURE IN STEAM.

BY ROBT. W. KING, M.E., TORONTO.

Some years ago, wishing to call attention to the excellence of some boiler evaporation test taken from a battery of boilers of peculiar and novel design I caused a copy of the tests referred to to be placed before an authority in mechanical engineering. The answer I received was to the effect that the record was worthless from two causes. First. Because it was not shown that it had been taken by an independent authority, and on its own face, because no calorimeter trials for percentage of moisture in steam had been taken, it being explained that though the results as shown were exceedingly good, their very excellence led to a suspicion that their apparent efficiency might to a large extent be due to poor circulation in the boilers themselves, causing water to be carried off with the steam unevaporated. The following may be within the experience of many of my hearers.

Boilers are sometimes sold, and guaranteed to give a certain power and efficiency, and on being installed, an expert is sent to conduct a test and see that all is correct, and to the guarantee, he gets independent evidence as to weights of water and coal, submits his report showing a percentage of gain in excess of the guarantee, and the transaction is closed. Six months or a year afterwards the test may be repeated, but never again are as good results as first shown obtained. Various reasons have been advanced as to the cause of this: The boiler has become incrustrated with scale, or the brick work has become cracked and leaky, or the firing has never been as expertly done, or it was a picked sample of fuel employed during the trial test, etc., but I have not heard it suggested that a new boiler will throw more water over with the steam than an old one.

Now why should it not? The amount of oil or grease used in the construction of the boiler causes a tendency to prime or in more familiar terms "to boil over," in fact, with some designs it is difficult to keep the water in at all when boilers are new, and pressed to their full capacity. This effect is particularly noticeable in boilers that have a small amount of water surface in proportion to their amount of heating surface, the steam, leaving the surface of the water with the extra rapidity due to a proportionately contracted area, carries more of the water with it, time not being allowed for the water in suspension to settle or fall away from the rapidly rising steam.

With this theory in view we can well understand that it is possible to design a boiler so near the limit in this respect that under easy or even normal firing fairly dry steam may result, but on pressing the boiler above this normal limit a large proportion of water can be made to pass away with the steam unevaporated. I once stood by during a competitive test between two boilers, one of exceptionally large water surface, and another that was deficient in that respect. On noticing how vigorously the fire with mechanical forced draft was being pushed in the latter case, I questioned if more economical results could not be obtained by lighter firing so that less heat might be discharged into the chimney flue, I was answered, "no; the only way to show the highest rate of both duty and efficiency in those boilers is to shove the firing for all it is worth." Noticing no calorimeter tests were being taken I drew my own inferences, and my hearers are at liberty to do the same.

In further illustration of the importance to be attached to calorimeter trials as herein discussed I will give another instance: A man has a battery of boilers doing a certain work and obtaining certain specified economical results, or in other words at a certain cost per unit of steam. He wishes to increase the work the boilers have to do to a considerable extent, and a mechanical engineer is asked to advise him if, and how, the increased duty can be obtained? And at what extra cost, if any, per unit of steam? You may plan the necessary changes theoretically required, and apparently prove by evaporation tests that the extra duty has been accomplished, and place at the same time the evaporative efficiency at its indicated point, but your work and your test may be all moonshine, and deceive your client rather than help him unless you have ascertained either theoretically from measurements as at first indicated, or experimentally proven by calorimeter trial, what is the thermal efficiency of the steam under both conditions.

Having shown the importance of calorimeter trials it is hardly necessary to refer to the necessity that the same shall be carefully and expertly taken, and if for scientific purposes that the instruments used must be such that their reliability, and accuracy may be beyond question, to be so, their virtues in this respect must to the engineer using them be self-evident.

Of course it would be very nice to have a so-called portable calorimeter to carry in your vest pocket, and by attaching it to a steam pipe (with your pocket handkerchief wrapped round the connection to keep it warm), read off on a dial the thermal efficiency of the steam, but I do not want any instrument, any more than I want any man, to give me results that I have to be saved by, or damned by, that cannot show me the inward working thereof, and a reasoning that my own personal intelligence can follow and approve. My faith in patent calorimeters for this purpose got a shock some years ago. After the snub my dandy evaporation tests (first referred to), received at the hands of the learned professor not named, I ascertained the make of the calorimeter he was himself using in his private outside practice. Finding it was borrowed, I succeeded in obtaining, by equally legitimate means, the same instrument, and having it applied by a graduate of his university to the boilers in question, it was an expensive trial both on time, and extra accessory requirements, but not a single reading was obtained that did not show superheated steam in a boiler not having one inch of superheating surface.

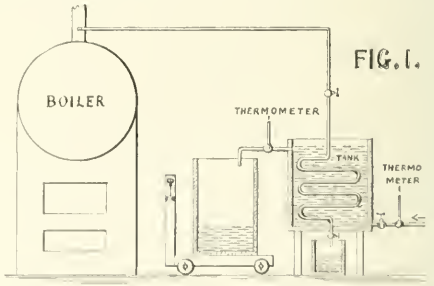


FIG. 1.

The first reasons given me was that it was not reliable under that particular pressure of steam. On pressing then for one that was, a total of a (claimed), corrected reading was sent me, to several decimal places showing some moisture but with the statement that it was practically dry steam. The man who made that report might be able to swear to it, but the writer is not, so that is not the kind of instrument he wants.

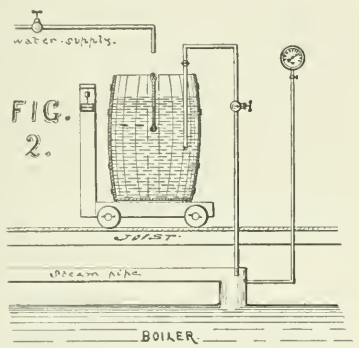
I am again interested in calorimeter trials having by changes in the fires and according to evaporation tests doubled the steam making duty, of the self same boilers, and the question that now has to be answered is how much of this apparent extra duty can be relied upon for service. The way being taken to answer that question will now be put before you, and I ask that the methods as shown, and the results obtained may receive your kindest criticism. I want to see if they will stand the fire of this club, feeling that there should be some present

who have had more experience with, and know far more about this subject than the writer of this paper.

By the method illustrated in Fig. 1, steam taken from the boiler is condensed in the coil in the tank and at periodical intervals is drawn off, weighed and temperature observed, thus the quantity in heat units drawn from the boiler is estimated. In contra to this value the water passing through the tank is weighed and temperature noted at entrance and exit. Since the water available was of irregular temperature a difference of ten degrees having been recorded in previous operations it is obvious that considerable complication would encumber the working out of data obtained from this method without a further arrangement of apparatus by which this difficulty could be overcome.

This method, however, is one that has been used with good success, and is highly recommended. The method employed in these trials to which your attention is being called is illustrated in Fig. 2. You will note by the drawing board that the measuring instruments are a set of scales, a thermometer and a steam gauge. The accessories are a common oil barrel, a pipe and a piece of hose, connection from steam to be tested to the barrel as shown and water supply. It is hardly necessary to state that correct measuring instruments as enumerated should already be in the possession of anyone undertaking boiler tests, and evaporation measurements, and that the balance can be obtained on the ground and instructed to be in place prior

FIG. 2.



to your visit. The modus operandi will be sufficiently referred to as I place a set of measurements before you. Having taken the weight of the water in barrel at 329.5 lbs., and its temperature at 54 F. and blown steam through the connecting pipe to heat it up, I plunge the hose in the barrel, noting time and steam pressure every five minutes, the position of the hose in barrel causes water to circulate, I cover the top of the barrel and all pipe connections in use including the handle of globe valve with heat non-conducting material.

It is desirable to make all such trials as uniform as possible so I add each trial just 30 lbs. in weight to the barrel by the addition of steam blown in, then for comparative purposes the resultant increase in temperature of the water operated upon will determine without figures the proportional thermal efficiency of the steam being tested, and is a good way to explain it to uninitiated proprietors, whose faith in you and your appliances will be increased, and their interest awakened, by finding the process is within the possibilities of anyone endowed with good common horse sense to understand.

In obtaining uniform conditions the main difficulty is with the steam pressure. For this reason I propose in close measurements that a reducing valve be used to keep the steam being operated upon constantly at an even and predetermined pressure. In submitting for your examination the data and its working out of a number of trials I would say that these were undertaken on the impulse of the moment, mainly as comparative tests, and having neglected to take with me at the start some standard instrument, I made the trials with such as were at hand, so while the deductions show conclusively the comparative merits of the plants operated upon, still for standard or comparative records outside of the plant referred to, some calibration of the instruments used will be needed and suitable corrections made, which I have not so far accomplished. You will notice my last observations were only taken on the 2nd of March, and this paper is being read ahead of its order, as first agreed upon. There are [illegible] reasons to be noted for the slight variation in the averages of the three sets of trials submitted, for instance the first test of February 4th, was started in a cold barrel, the last test of March 2nd, you will notice by the data, occupied 35 minutes owing to low steam, as against 15 and 20 minutes respectively to the previous trials, so that the trials that are longest in hand show a corresponding loss of head by radiation from the sides of the barrel, which is an interesting illustration of the improvement that would be made in the records, were an even head of steam maintained as previously proposed. In reference to January 30th, there had been occasional slight indications of priming during an evaporation test, being conducted two weeks previously showing the necessity of confirmation by calorimeter trials. I think the tendency to prime may not have entirely disappeared on Jan. 30th, making results somewhat irregular, and total average result slightly below the later trial of March 2nd, taken from the same boilers, though under a higher evaporative duty. I submit that the whole series of trials illustrate largely the importance of uniformity in the performance of all tests and trials of this character wherever practical, and to depend on this method, as a comparative guide rather than to bring irregularly conducted trials no matter how closely and expertly observed to a common basis for comparison by means of complicated formula and calculations. It is also clear that the plan of calorimeter trial for moisture in steam as herein exemplified is open to great possibilities, deserving more attention from mechanical engineers than has hitherto been devoted to that subject. An interesting criticism and discussion followed on the above paper read before the Engineers' Club of Toronto, Prof. Galbraith, principal of the School of Practical Science; W. Monds, F.S.P.S., Cecil B. Smith, C.E., and others taking part.

Prof. Galbraith said that methods such as had been so ably presented by Mr. King were the only ones possible to use some years ago, but since his (the speaker's), experience was mainly with high pressure steam where more modern instruments were used he had no actual practise to refer to in such work as now under consideration. In modern instruments depending on the velocity of steam for the separation of water entailed therein by centrifugal force, it would not be likely that with low pressure steam of corresponding low velocity the results would be as correct as where used for high pressure, so with those working of necessity with low pressures, the data given and the methods of obtaining and working out the same as illustrated by Mr. King were of particular interest, there being no doubt that with correct and reliable instruments, close observation, supplemented by a measurement of heat losses from absorption by the barrel, etc., very reliable results could be obtained.

Discussion arose as to what the error in final results would be from incorrect measurements of temperature, or weight of water or steam. Trial calculations were thereupon made and following results obtained:

One-quarter lb. in weight of steam, change efficiency from .973 to .982, equals .009 of 1%.

One-quarter lb. in weight of water, no effect in 3 decimal places

One degree temperature of water, changes efficiency from .973 to .984, equals .011 of 1%.

One lb. in steam pressure changes efficiency from .973 to .9744, equals .0014 of 1%.

A vote of thanks to the reader of the paper closed the discussion.

CANADIAN MINING INSTITUTE.

The annual general meeting of the Canadian Mining Institute was held in the clubroom, Windsor Hotel, Montreal, on Wednesday, Thursday and Friday, March 6th, 7th and 8th, 1901. The following members were in attendance: J. Stevenson Brown, Harry Wilson, A. S. Blakemore, F. R. Clark, Charles C. Hanson, Prof. John B. Porter, R. T. Hopper, Dr. Frank D. Adams, W. Blakemore, Francis T. Peacock, J. E. Hardman, Wm. T. Bonner, W. R. Elliott, R. B. Ross, B. F. Peacock, George McDougall, S. J. Simpson, W. S. Hopkins, C. V. Corlis, W. M. Edwards, W. G. Flint, of Montreal; B. T. A. Bell, F. D. Lovell, Dr. Robert Bell, Dr. H. M. Ami, R. G. McConnell, of Ottawa; J. F. Latimer, J. M. Clark, K.C., LL.B., of Toronto; Prof. R. Carr-Harris, Dr.

W. L. Goodwin, Prof. W. G. Millar, Prof. Courtney DeKalb, G. C. McKenzie, Capt. Bruce Carruthers, Major R. G. Leckie, of Kingston; T. R. Gue, A. McNeill, H. M. Wylde (secretary Mining Institute of Nova Scotia), of Halifax; Jas S. Mitchell, Jas. F. Lewis, of Sherbrooke, Que.; G. W. Kerr, Belmont; W. A. Hungerford, Belleville; Thomas Brown, Republic, B.C.; D. W. Robb, Amherst, N.S.; George R. Smith, Thetford Mines, Que.; Charles Brent, Rat Portage, Ont.; Charles Fergie, Westville, N.S.; S. D. Wright and P. Kirkegaard, Deloro, Ont.; J. Obalski, inspector of mines, Quebec; Hiram Donkin, Sydney, C.B.; John Blue, Capelton, Que.; A. B. Calabon, Rossland, B.C.

In the absence of the president, S. S. Fowler, the chair was taken by John E. Hardman.

After routine business, Secretary Bell gave the names of thirty-nine proposed new members. These were unanimously elected.

The treasurer, J. Stevenson Brown, presented his financial statement, which showed the total receipts to have been $4,055.37, and the disbursements, $3,424.70, leaving a balance of $630.61, or about $150 better than the previous year. But the balance would have been greater but for several items of special expenditure this year, including a donation to the patriotic fund of $250, besides $40 to the four members of the institute serving with the colors in South Africa. With the new members just added the total membership was 349. The report was adopted.

Secretary Bell, in presenting his annual report said, the institute had now a membership of 323, including 14 student members. The loss of six members by death was deplored, including their past president, Dr. George Mercer Dawson. Every member would deplore the untimely and unfortunate loss this country had sustained in the death of the director of the Geological Survey. The institute had already taken steps to put on record a permanent memorial of its appreciation of what Dr. Dawson had done for the mineral development of the Dominion, and had opened a subscription list, to which the institute had subscribed $100, for the purpose of painting a portrait to be presented, in conjunction with that of Dr. Selwyn, to the museum of the Geological Survey. At a later stage of the annual meeting, Dr. Ami would present a review of Dr. Dawson's work. The institute had had four members out in South Africa—Major Merritt, Lieut. Leckie, Mr. Brown and a son of W. Blakemore, the latter being with the Strathcona Horse, besides their old friend, "Gat" Howard, since killed, who although not a member of the institute, was a mining man. The report was adopted.

W. Blakemore, P. Kirkegaard and the chairman, were appointed a committee to prepare a resolution on the death of Dr. Dawson, and subsequently presented the following, which was unanimously adopted:

"Resolved, That the Canadian Mining Institute in annual session assembled, desires to place on record its sense of the deep loss sustained by the Dominion of Canada, and especially by the mining profession of the country, in the lamented death of Dr. G. M. Dawson, late director of the Geological Survey. It recognizes the immense value of the services which he rendered in the important position which he occupied with such distinguished ability, and no less the high qualities of mind and personal character which he displayed. The institute wishes further to express its sympathy with his surviving relatives in their irreparable loss, and herewith forward a copy of this resolution to them."

Secretary Bell stated that the library, which was now worth $15,000, was increasing; in fact, they had not half enough room for what they would receive during the coming year. At a meeting of the council on the previous evening, they practically agreed to take in any society of mining students, en bloc, at a fee of $1 per head—that is to say, the mining students of McGill University, Queen's University, or the School of Practical Science of Toronto, would have all the privileges of the institute for $1 a year.

After the scrutineers for the election of officers had been appointed, Secretary Bell called attention to the inadequate remuneration of those engaged in the Geological Survey. It was no wonder that the best men were being allured elsewhere at considerable higher salaries—notably Mr. Carlyle, who was getting a salary of $25,000 at the Rio Tinto mines in Spain, Mr. Eugene Coste, Mr. McNutt, Mr. Tyrrell and Mr. Low, the latter having connected himself with a wealthy Philadelphia firm. He thought it was the duty of the institute to call the attention of the Government to the fact that, in their opinion, the salaries received by the gentlemen engaged in the Geological Survey were wholly inadequate to the services they were rendering to the country. He thought they should also again urge upon the Government the necessity of providing proper quarters for the geological specimens which were housed at Ottawa. The present accommodation was not only wholly inadequate, but might be destroyed by fire or might tumble down on the members of the staff at any time.

Dr. Goodwin said every member of the institute would endorse the remarks of Mr. Bell. The Government did not show, by the amount of money it appropriated, sufficient appreciation of scientific work in the development of the resources of the country. The resolution should be strongly enough worded to make some impression at Ottawa.

E. D. Ingall alluded to the fact that we had no national museum. They were not aware of the very useful information about the rocks of the country, etc., that was in the museum, but was packed in boxes, so that mining men going to Ottawa could not get at the information they wanted.

Dr. Adams said this was a question of national importance. Our best men were taken off by the mining companies. While they received their theoretical training in the universities, it was in the Geological Survey that they received the practical training in field work. He suggested the appointment of a delegation to wait upon the Government at Ottawa.

On motion of Prof. Carr-Harris, the following committee was appointed to prepare a resolution on the subject and to act as a delegation to present the same to the Government: Prof. Carr-Harris (chairman), Dr. Adams, Montreal; Charles Fergie, Westville, N.S.; W. Blakemore, Montreal; B. T. A. Bell, Ottawa; A. J. Moxham, Sydney, C.B.; H. M. Whitney, Boston; F. H. Clergue, Sault Ste. Marie; Bernard Macdonald, Rossland; S. S. Fowler, Nelson, B.C., and J. M. Clark, K.C., Toronto.

Eastern Ontario, with Belleville as the centre, was decided on as the field of the next summer meeting.

Prof. Carr-Harris called attention to the fact that a renewed effort was to be made this coming session in the Ontario legislature, and some of the other provinces, for the close incorporation of the Canadian Society of Civil Engineers, which had already obtained incorporation in the province of Quebec, and he warned the members of the institute against entertaining any half-way measures or compromise regarding the bill. One of the clauses of this act declared that "the expression 'civil engineer' means anyone who acts or practices as an engineer in advising on, in making measurements for, or in laying out, designing or supervising the construction of canals, aqueducts, drains, harbors, docks, light-houses, river improvements, dykes, dams, railways, bridges, power-plants, waterworks, sewerage works, and all hydraulic, municipal, sanitary, electrical, mechanical or other engineering works, when the estimated cost of such works exceeds $1,000." It was simply nothing more nor less but an attempt to sweep out of existence any competition with its members. The Canadian Society of Civil Engineers had been seeking this act repeatedly in the legislature of Nova Scotia and Ontario, but the bills were thrown out in committee. The society had used the pleas of apprenticeship, diplomas, examinations, safeguarding the public, etc., behind which it had covered its desired bill, which contained provisions absolutely taking away the right to practice civil engineering from every person outside of its list of members; for instance, four-year graduates of engineering colleges, expert engineers of other countries, and hundreds of well established and highly experienced Canadian civil, mining, mechanical and electrical engineers, who do not belong to this society would be swept out of competition with its members. In a "memorandum for the use of the provincial committees on incorporation," issued by the society, it was declared that "Engineers in Europe and America are divided into two main branches, viz., civil and military, the former embracing engineers in all classes of engineering work. In European countries, including Great Britain, engineers are required to pass an examination or to be regu-

larly apprenticed for a term of years before they can call themselves civil engineers or practise as such. In Canada civil engineering is the only learned profession to which an unqualified person can claim to belong, and 'civil engineer' is the only professional title which can be assumed by any person, whether educated or not." Now, it was a question whether the qualified persons were inside or outside of this society. Prof. Carr-Harris read a letter which he had received from Charles Warren Hinch, secretary of the American Society of Civil Engineering, stating that there was no protection by law to the profession of civil engineering in the United States, and another from J. H. T. Tudsbery, secretary of the British Institute of Civil Engineers, stating that engineering in the United Kingdom was in no sense a close corporation or protected by law. He merely brought this question up to warn the members of the institute against accepting any compromise which might introduce the thin edge of the wedge.

Secretary Bell said that the Quebec Act was passed before the institute knew anything about it, but as soon as they did they had tried to have it rectified. They could not define the term mining engineer; there were men in their ranks who were not graduates of any school or college, but who had gained their knowledge by hard experience, and these men could not be legislated against by any university.

Prof. Carr-Harris said that the Dominion Institute of Amalgamated Engineers, which was formed a few years ago, had a constitution of the most liberal character. While they approved of apprenticeship and of examinations, they had not the faintest idea of forcing other people to do the same. It condemned close corporation privileges; it included in its ranks civil, mining, mechanical and electrical engineers. Its members included such men as Sir Sandford Fleming, C.M.G.; Thomas Nash, chief engineer of the Kingston & Pembroke railway; Mr. Tandy, mechanical superintendent of the Kingston locomotive works; Mr. Soper, electrical engineer, of Ottawa; Mr. Powell, mechanical engineer, of Ottawa; Mr. Bell, secretary of this institute, and Dr. Goodwin, head of the Kingston School of Mines.

Wm. Blakemore, M.E., read a paper on "Pioneer Work in the Crow's Nest Coal Areas." In opening, he referred to the fact that the late Dr. G. M. Dawson was the first, in 1881, to recognize the possibilities of these coal areas, and said, that while he might be called the scientific discoverer of the Crow's Nest Pass, we should appreciate the men who first discovered the actual existence of coal, and especially to William Fernie, who in the late seventies, discovered at an elevation of about 6,000 feet the outcrop of the 30-ft. seam, and from then until 1806, when the Crow's Nest Pass Coal Company was formed, never ceased to clamor for the building of a railway and the development of the mines. But for the tenacity and ability with which he clung to his scheme, there would probably to day not have been either a Crow's Nest Pass or a railway. Mr. Blakemore then described the location of these coal areas, which lie longitudinally upon the western side of the first range of the Rocky Mountains, near the country which separates British Columbia from Alberta. Coal seams are found in the cretaceous formation, and are inter-stratified principally with sandstone and shales super imposed upon carboniferous limestone, and below this proceeding westerly are found Cambrian rocks. The extent of the coal field is theoretically 90 miles long, running north from the south fork of the Elk river, but the actual limit of the coal basin, which is not disturbed and can be counted on to yield workable coal, extends only a distance of 30 miles north of this point, where the limestone comes to the surface, and the coal measures are so broken up and disturbed as to practically terminate at a point four or five miles north of Michel Creek. Allowing for the areas which have been eroded between the various mountain peaks in the creeks, it is probable that the nearest estimate obtainable of the area of workable coal is not less than 150 square miles, and Dr. Selwyn, the late head of the Geological department, computed the available coal to each square mile at 24,976,000 tons. The pioneer work with which Mr. Blakemore was connected commenced in December, 1897, and when the railway reached Coal Creek in August, 1898, there was a stock of 10,000 tons of coal banked. Plant had already been ordered and within four months of the railway reaching Coal Creek everything was in running order, and there was a daily output of 300 to 400 tons of coal, and 50 coke ovens were producing coke. He gave the following analyses of coke:

	Carbon.	Ash.
Crow's Nest, British Columbia	91.97	8.03
Crested Butte, Colorado	89.00	11.00
Cardiff and Sunshine, Colorado	87.18	12.82
Belt, Montana, washed coal	91.00	9 00
Connelsville, Pa.	86.88	11.54
Trinidad (Colorado), washed coal	85.00	15.00

Another analysis of a seam, which has not been worked, gave carbon, 95.93, and ash, 4.02. This coke, which costs about $7 a ton, has entirely replaced Welsh and Connelsville coke, which had previously to be imported at a cost of $15 to $20, and Mr. Blakemore predicted that in less than five years this coal field will supply the entire consumption of coke in British Columbia, Montana and Washington Territory, and probably 50 per cent. of the raw material required. He spoke of the conditions on which this coal field is occupied and the safeguards which the legislature had wisely put around it, and concluded by saying that these coal areas would well repay watching. They will furnish the key to the success of western mining and settlement, and long after those who were engaged in the pioneer work of that section have been called to another sphere, western Canada will be enjoying the fruits of their labors.

Dr. Frank D. Adams contributed some "Notes on the Iron Ore Deposits of Bilboa," illustrated by slides. He referred to the iron ore deposits in general in Spain, and said that the most important, and those which seemed to be, as far as we knew, more extensive, lay in the Basque province, and, finding their port of shipment at Bilboa, were commonly known as the Bilboa deposits. Although the ores were worked from very early times, they found their greatest development with the inauguration of the Bessemer process of steel making. About 87 per cent. of the iron ore imported by Great Britain was shipped from these mines. By those who had studied these deposits it was said that the ores were getting poorer in quality and were near exhaustion, but as there were others in the interior of Spain, it might be considered that for some years to come the Spanish supply of ore would continue undiminished.

At this point, Secretary Bell expressed the pleasure he had felt at learning, through the press, that no successor to the late Dr. G. M. Dawson had yet been appointed, and said that the council had on the previous evening come to the conclusion that the gentleman who should be the director of the Geological Survey of Canada was Dr. Frank D. Adams.

James F. Lewis, Sherbrooke, expressed his approval of such an appointment, and the secretary was authorized to send the following telegram to the Minister of the Interior, at Ottawa, which was agreed to: "Canadian Mining Institute at large, and representative meeting to-night, unanimously recommends appointment of Dr. Frank D. Adams, an old member of the survey staff and Logan professor of Geology, as successor to the late Dr. Dawson."

In connection with the students' prizes, it was announced that the president-elect, Charles Fergie, of Westville, N.S., would give a gold medal to the student submitting the best paper during the year.

THURSDAY.

Secretary Bell submitted a paper by Frank Robbins, M.E., of Kimberley, B.C., on "A Simple and Convenient Instrument for Mine Surveys," the construction of which was described as follows: A strip of hardwood about an inch wide (depending upon the sockets of the tripod head), and an inch and a half deep, a trifle shorter than the ordinary tripod leg, is cut in two. Each half is then ripped through the major part of its length, say to within three inches of each end; the slit is enlarged to about 3-16 of an inch, it is on the deep side and as accurately as possible in the middle of this. The two pieces are of equal rectangular section, that is they do not taper, except the lower one, which at the end is trimmed to a point and tipped with iron. Two brass screws with square heads and thumb-screws are fitted to each pair of pieces. These screws couple each pair together through the long slot, and by means of them the tripod legs can be extended to their full length for use or reduced to the length of a roll of blankets.

J. Obalski, inspector of mines of Quebec, read a paper on "Notes on the Magnetic Iron Land of the North Shore of the St. Lawrence," which is summarized elsewhere.

The chairman asked in what quantities the ore could be used in blast furnaces, and R. T. Hopper said that the difficulty had been that there never had been a sufficient quantity taken out and shipped to furnaces to make a continuous test. There have been small quantities tried in a laboratory way; but it requires several hundred tons to make a mixture and run in the ordinary blast furnace.

Dr. A. R. Ledoux, of New York, gave some random notes on the Oregon nickel mines, in which he showed how they had failed to produce nickel, simply because the prospectors and promoters would not understand the sort of deposit they had to deal with, and spent their money boring holes when all the ore was on the surface.

P. Kirkegaard and Sydney B. Wright, both of Deloro, Ont., contributed papers on the "Treatment of Auriferous Mispickel Ores." These ores, occurring in Hastings county, Ontario, were discovered in 1867, when there was a great rush into the district. Then it was found that the ore was very difficult to work, and there was a great rush out again. Messrs Kirkegaard and Wright, however, have succeeded in making the mispickel give up its gold, which it contains in a finely divided condition, and also have the only plant on the continent which turns out arsenic in commercial quantities. The ores are milled and treated with potassium, cyanide and cyanogen bromide, about 90 per cent. of the gold being recovered.

W. A. Hungerford, of Belleville, spoke of the North Hastings areas, and particularly the mispickel belt. Of the many thousands who went to that district to look for gold in the early spring of 1867, he was the only one left. He had been in that section ever since then, and had been connected with mining almost continuously from that time, although engaged in other pursuits, and had seen the rise and fall of every enterprise that had taken place, from the excitement of the Richardson mine until the present time. Himself and Mr. McDermot, an old Australian miner, were the first to discover gold in the township of Marmora, some 300 yards from where Mr. Kirkegaard was now operating. No one was prouder than he to think, after a long time spent in that section, that the ores in that particular belt had been mastered, and they could now look forward with confidence to the success of that section of mining country, and before long they would see many mills in operation there. In the early treatment of these ores, if they got 40 per cent. of the gold on the plates by amalgamation, they thought they were doing well. He was now obtaining from 75 to 82 per cent. A false impression with regard to that section of country was that all the ores were supposed to be refractory. That was not the case. In the townships of Marmora, Madoc, Tudor and elsewhere, the free milling ores would go from 40 to 120 feet wide, and he had no doubt that when the country became known and capitalists had their attention drawn to it, in a few years large mills would be working these deposits.

Dr. H. M. Ami, of the Geological Survey, read a very appreciative obituary of the late Dr. G. M. Dawson. Through Dr. Dawson's energies and those of his staff much had been done to establish mining in Canada. Dr Dawson had done much in disseminating a knowledge of the west, and his death was an irreparable loss to Canada and science, and especially to the Geological Survey.

At the evening session George Macdougall and G. F. DeCourtenay were elected auditors and Dr W. L. Goodwin read a paper on the "Analysis of Corundum." He remarked that corundum was now being produced by the Canadian Corundum Company of a very high grade, viz., 95 per cent. of pure corundum. When it was remembered that hitherto manufacturers had contented themselves with a corundum of 80 per cent., it looked as if the Canadian product should have a good market, because the pure product would be preferred by manufacturers of emery wheels and the like.

Secretary Bell then gave a summary of the mineral production of Canada in 1900. During the past year the Dominion had produced minerals of a value at the pit mouth of between $63,000,000 and $65,000,000, as compared with $40,000,000 in the previous year. Taking up the provinces separately he said that in British Columbia the lead production was over 200 per cent. above that of 1899; silver, nearly 75 per cent.; copper nearly 20 per cent.; lode gold, 20 per cent.; coal, about 120,000 tons increase. In the Yukon the gold production was at least $25,000,000. On the North Saskatchewan river gold dredging was only in an experimental stage, and in Alberta the output of coal was, bituminous 304,000 tons, and anthracite 17,500 tons, and the formation of new companies indicate considerable development in the near future. In Assiniboia the production of lignite would show an increase over previous years. In Manitoba a large number of mining claims had been recorded during the year, and several gold mining properties were being opened up, whilst the gypsum deposits lying north of Lake St. Martin were being rapidly staked out. The total value of minerals produced in Ontario during 1900 was $9,280,424; number of workmen employed, 11,109, and paid in wages, $3,164,400. With the exception of gold, the output of which was 18,767 ounces, valued at $297,861, there had been an increase in almost all the minerals produced in Ontario. Mining in Quebec was chiefly remarkable for the flourishing condition of the asbestos industry, the approximate output of which was 23,251 tons of all grades of fibre, and nearly 7,000 tons of asbestic, estimated to be of a value of not less than $1,000,000. Iron ores showed an increase over previous years, and in minerals of all kinds. Quebec might be credited with an increase of $500,000 over 1899. In Nova Scotia the output of coal had been the largest in the history of that industry, the sales amounting to $2,955,000. The output of gold amounted to 31,110 ounces, as compared with 27,772 ounces in 1899. The total production of minerals in Nova Scotia might be estimated at $11,000,000. Considerable development had taken place in New Brunswick in the production of manganese, and there was some talk of the erection of a ferro-manganese plant near Moncton. The oil shales at Baltimore were being developed with a view to exporting to the British market.

E. D. Ingall gave the results of the reports so far received by the Geological Survey. Copper shows an increase of 15 per cent. for the whole Dominion, and gold 33 per cent. Nickel showed an increase of 40 per cent., and silver 44 per cent. for the whole Dominion. The increase in asbestos, according to the figures given to the survey, was 58 per cent., hardly as high as Mr. Bell anticipated. Coal had increased 40 per cent., coke 75 per cent., and graphite was nearly double the production of the previous year. Gas only increased 8 per cent., and petroleum showed a slight falling off. In pyrites the increase was 39 per cent.; salt, 20 per cent.; cement, 10 per cent.; structural materials and clay products, 15 per cent.; metallic materials, 43 per cent., and non-metallic, 33 per cent. The increase in the grand total comes to about 35 per cent. over last year.

Secretary Bell said that the Canadian mica miners had formed a very representative association called the Canadian Mica Miners' Association, and they were collecting and had in their possession a vast amount of information hitherto unpublished concerning that industry, and which for commercial reasons they were keeping to themselves. They were considering the advisability of establishing a central warehouse, either in the Kingston or Ottawa district, to buy up all the mica in Canada on a cash basis. The difficulty had been to have a standard size, and another great difficulty had been to get rid of the smaller size. The situation seems to resolve itself into this factor—the miners will have to reduce the price on the larger size and increase it on the smaller. With a central warehouse, if a farmer has any mica instead of uploading it on a broker he can come to the warehouse and sell it for cash. It would be in a position to handle the product in the United States direct, and also in Great Britain direct. In that way we should develop new markets for minerals, establish prices, do away with unfortunate competition and kill the middle men. A vote of thanks was tendered to Mr. Bell for his interesting review.

FRIDAY

The scrutineers reported the result of the election of officers of the institute as follows:

President—Charles Fergie, M.E., Westville, N.S.

Vice-presidents—R. R. Hedley, metallurgist, Nelson, B.C.; Graham Fraser, ironmaster, New Glasgow, N.S.; Dr. Frank D. Adams, geologist, Montreal; James McArthur, Sudbury, Ont.

Secretary—B. T. A. Bell, editor Canadian Mining Review, Ottawa.

Treasurer- J. Stevenson Brown, Montreal.

Council—For British Columbia, John B. Hobson, M.E., Quesnelle, B.C.; W. F. Little, colliery manager, Anthracite, N.W.T.; E. B. Kirby, M.E., Rossland, B.C.; Bernard Macdonald, M.E., Rossland. For Ontario, Prof. Courtenay De Kalb, M.E., Kingston; P. Kirkegaard, mine manager, Deloro, Ont., Major R. G. Leckie, Sudbury, Ont.; R. G. McConnell, geologist, Ottawa. For Quebec, George R. Smith, mine manager, Thetford Mines, James T. McCall, iron merchant, Montreal; James F. Lewis, mechanical engineer, Sherbrooke; J. Burley Smith, M.E., Montreal. For Nova Scotia, R. E. Chambers, M.E., Bell Island, Nfld.; D. W. Robb, mechanical engineer, Amherst, N.S.; J. R. Cowans, Springhill, N.S.; R. F. McNaughton, Forest Hill, N.S.

CHARLES FERGIE, PRESIDENT, CANADIAN MINING INSTITUTE.

Prof. J. B. Porter read some notes on Laboratory Work at McGill University, and Prof. Hardman spoke of the great value of the experiments made at McGill, on account of their disinterestedness. As a money-making profession, mining engineers must depend for more accurate information on this work, done without hope of reward.

The meeting then resolved itself into a students' session, papers being submitted as follows: "The Coal Mines at Fernie, B.C.," C. V. Corliss, McGill; "The Concentration of Silver Lead Ore at Gem, Idaho," W. M. Edwards, McGill; "Notes of Crushing and Screening under Varying Conditions in the Ore-Dressing Laboratories at McGill University," W. G. Flint, McGill. A paper on the Coal Mines at Sydney, C.B., was also read by Mr. Ritchie.

At the afternoon meeting J. E. Hardman retired from the chair and introduced the new president, Charles Fergie. Mr. Fergie briefly returned thanks for the honor done him, and assured the members that the institute would receive the whole of his attention in all matters tending to promote its usefulness.

Three new members were elected, after which J. M. Clark, K.C., LL.B., submitted a paper on "Company Law." He referred to the law of Ontario and to that of Quebec, as well as to the law of the Dominion, and pointed out the most important provisions of the new English law. He said it would be greatly in the interests of all the provinces and the Dominion, if we had a comprehensive system of company law, which would be practically uniform throughout the whole of Canada, and be in such shape that it would be easily understood and authoritatively declared, so that mining men would know exactly what the law was in any province of the Dominion in which a company proposed to do business.

Mr. Laws, of London, Eng., had been present in the House of Commons in Great Britain when their new law was passed, and he complimented Mr. Clark for the clear exposition he had given of the law in this country. He thought that if the Canadian law should be made to conform more to the British law it would be better for all parties concerned.

Rufus H. Pope, M.P., said there was no reason why bank directors should not advance money for mining projects in the same way that they did for the pulp mills and other industries. Mining was just as important to the country as pulp mills, but when one went for an advance the directors would ask if any of it was for mining, and if the answer was in the affirmative, they refused in toto. He did not think that was right.

Prof. W. G. Millar read a paper on the "Iron Ore Fields of Ontario." He said that from what he now knew of the iron ore fields of that province, Ontario was assured of a great future as an iron ore producing country. It should in the not far distant future take its place as an iron ore producer second to no other country.

Dr. Ami presented a paper on the "Sedimentary Deposits of the province of Ontario and the Boring Operations carried on in them. The other papers on the Syllabus were taken as read.

The proceedings terminated in the evening with an informal dinner, and a pleasant evening was spent with songs and instrumental music by members of the Zingari Club, Montreal, interspersed with speeches by the members.

THE NORTH STAR MINE AND NICKEL PLATE MINE OF BRITISH COLUMBIA.*

SOME DETAILS OF THEIR OPERATION.

By J. M. Turnbull, B.A.Sc., McGill, '97.

Shaft Sinking.—The shaft is located by survey, and then a peg put in the ground at each corner. The North Star shaft is a two-compartment vertical one, and was pegged out about 8-ft. by 14-ft. The miners dug to bed rock, about 4-ft. down, with pick and shovel, then began to drill and blast, generally placing cut holes so as to blast out a wedge along the centre of the shaft and squaring up with vertical side holes. The drilling was done by hand, using 7/8-inch steel, and blasting done with 40% Giant powder exploded by 3x caps and ordinary fuse. When the shaft reached a depth of 8 feet the timbering was started. Two thin stulls were put in about 3 feet from the bottom, and 3 feet away from and parallel to the ends of the hole. The wall plates were then laid on these, the end plates laid in place, and the centre plate, and the whole accurately squared and levelled by the aid of squares and diagonal sticks and carpenter's level. Before wedging up the sett should be set by the surveyor if the shaft be intended to make any connections; when in the right place and accurately levelled, the sett is wedged so that no force tends to bend any of the timbers. This operation must be carefully performed so as to get the timbers in good and tight, equally strained, and at the conclusion perfectly square and level. The six posts are then put in and the sett above is placed in position.

In the wall plates of each sett four holes are bored, two at each end. Iron hangers are passed through these to hold the setts together. These hangers are made usually of 7/8-inch round iron, occasionally of 1-inch stuff, while the washers are the ordinary cast-iron washers which are designated as "7/8-inch" or "1-inch" cast washers, according to the size rod they are to fit. The sett being screwed up tight by the hangers is carefully plumbed at the corners over the sett below and wedged and blocked in as before, always watching the squaring, etc., carefully.

The posts are placed above this sett as before, and the third sett placed in position. This sett projects about 3 feet above the ground, and is held in place by hangers. In some cases the timbering is carried higher than this, as where the ground is level, and therefore facilities for dumping are poor. The waste is in this case dumped round the shaft till the projecting timbering is all banked in and the dump can then work out radially according to circumstances.

At the North Star 2-inch rough sawn plank was used as lagging in 10 inch and 12 inch widths. Each plank was lowered endways outside the timbers until its lower end was opposite the centre line of the end or wall plate, and then wedged in place; this was continued until the whole setts were closed in. The lagging lapped over the posts slightly. All the spaces between the shaft walls and the lagging were filled and packed with earth and broken rock, making a solid job of the whole thing.

In continuing the shaft down a new sett is swung into

* Paper read before the Applied Science Society of McGill University and published exclusively in the Canadian Engineer.

place, as the blasting out makes room for it, always having three or four feet, if possible, below the most advanced timbers. This sett is plumbed, squared, etc., blocked into position, and lagging shoved into position from below or through the sett openings between the posts. The lagging is cut long enough to reach from the centre of a wall plate to the centre of the one below exactly. Filling is generally put in behind each plank as it is put into place. The North Star shaft had two compartments, each 4-ft. 6-in. square. The length of the posts is regulated by the distance apart of the setts, being shorter in heavier ground but usually four to five feet centres between setts. In framing timbers care should be taken to choose good sticks and allow for slight variations in the dimensions which occur in ordinary timbers, always remembering to cut so that the inside face of the setts will be accurately in line. At the North Star timbers cost about $25 per 1,000 feet, board measure, delivered four miles up hill to the mine.

In the Nickle Plate shaft in Rossland there were some modifications. Two trenches were dug, one on each side of the shaft, forming a V, with the point higher up hill than the shaft, and the lower ends about 50 feet apart. These extended to bed rock. Stulls were set across about two feet from the bottom, and round poles 6-inches to 8-inches thick, got by contract for from 4 to 6 cents per foot, were laid lengthwise on these, and earth was shovelled back in till the trenches were full up, thus forming two drains one on either side of the shaft to carry away all surface water and keep it out of the shaft. In this case also the top sett was about 8 feet above the ground, and two long sills 12-in. by 14-in. by 30-ft. were stretched one on each side of the shaft. A framework was then built up around the shaft timbers which formed a support for the gallows-frame, which of course could not rest on the shaft timbers. The cost of 10-inch by 10-inch timbers in Rossland was $12.50 per 1,000, delivered on the railroad siding from the State of Washington, where it was cut. In this connection I might describe the dumping arrangement used on the old shaft of the North Star, which was an incline shaft.

In this case a home-made skip of 2-inch plank was used, wheels being taken from an old car. The track was made of wooden rails broad-axed out of small trees (this was the usual material for houses, rails, orebunkers, etc., in this out-of-the-way place), these were from 3 to 4 inches square, and a double set of rails put in one above and one below the wheels, holding the skip to the rails at any slope. At the required dumping height the lower rails were cut, leaving spaces through which the front wheels could pass forward. On arriving here the front wheels would enter these spaces, and the skip tip forward on account of the way it is hung below the centre of gravity, while the back end would be lifted up and the ore dumped out. This skip held about 7 or 8 cubic feet. The hoisting engine was an old vertical boiler stationary engine, borrowed from a railroad, with a drum about 16-inches in diameter; the cable was a 5/8 in. iron one, and as indicator the engineer had a bit of rag round the cable, which rag just came to the drum when the skip was high enough.

In Rossland iron or steel buckets are generally used, which are usually about 42 inches long and 36 inches greatest diameter. The bale is usually of about 1 inch round iron with a loop for the clamp hook. A couple of lugs of 1-inch round iron or steel, spread out at the end into a square plate, are rivetted on to opposite sides of the bucket near the bottom. The bucket runs on skids about 20 inches to 24-inches apart on which pieces of strap iron about 1½-in. by ¼ in. are nailed with the flat side tangent to the bucket at point of contact. These are greased with a mixture of half and half tallow and black oil, which sticks very closely, as one will learn by contact. Near the point of dumping two outside skids are placed a little further apart than the diameter of the bucket, these catch the lugs on the bucket and straighten it up. At the point of dumping two irons are let into these skids (the inner skids do not reach this high). The bucket is hoisted just high enough for the lugs to catch in these depressions, and the engine reversed lowering the top of the bucket, which falls forward and dumps the bucket is then hoisted a foot or so above the depressions, and is lowered the lugs catching on swinging irons which swing forward by the weight of the bucket, carrying the lugs over the depressions, and then the bucket is lowered to the bottom on to a flat truck, the cable is unhooked, the empty is run into the drift, and a full one run out and hooked on.

General Details.—The North Star ore (a large fish shaped mass of galena), was broken down as best suited the place it was mined, most of the work being drifting, raising and sinking of winzes. The idea was when regular mining began to start at the ends and mine out, filling temporarily with square setts or otherwise, and then allowing the surface to cave in by removing timbers as in coal mining. A great deal of the ground was picking ground, but in harder ground powder was used, mostly No. 2 Giant, with 40% nitroglycerine. Drill steel used was ¾-inch and ⅞-inch octagonal, of a variety of brands as Canton, Crescent and Jessops, no comparative tests being made as to their qualities. Three and a half pound ordinary single hammers were used—picks, etc., were all of ordinary patterns. The ore was run out in cars which were loaded by muckers in the mine shovelling, or sometimes the miners themselves did their own mucking as in starting a winze. In fact working on a small scale every man had to be ready for temporary changes of occupation when occasion demanded.

The ore was dumped through the roof of the ore house on to the floor, any sorting having been done underground, and was shovelled into sacks, throwing out any barren lumps the shoveller happened to notice. This crude treatment was all the ore received. The sacks of ore ran about 18 to the ton. They were loaded on to sleighs (all hauling being in winter), which took about 4 to 5 tons down the hill each trip, making two trips per day with four-horse teams, the return trip being eight miles, and the difference in elevation of top and bottom about 2,500 feet. From the bottom of the hill to the landing, about 17 miles, it is mostly a slight down grade, and when the road gets icy and well packed a four-horse team has taken 10 tons on a load, making one trip per day, and occasionally have made 1½ trips. The record was claimed to be over 14 tons, which the members of the society are privileged to believe if they care to do so. From the landing the ore is loaded on boats and goes down the Kootenay River to Jennings, Montana, thence by rail to the smelter at Great Falls, Montana.

Since the present speaker was there the C.P.R. have opened up the Crow's Nest Railway, and built a branch to the foot of the hill whence an aerial tramway reaches to the mine, of whose working I have heard nothing. The method of sacking ore formerly in use at the Payne mine, Sandon, B.C., is an improvement over the crude method used at the North Star and was as follows: The ore was fed over a grizzly into a crusher which was run by a small gasoline engine, the crushed ore fell into a bunker from the lowest point of which a spout with gate projected into the ore house, about 3 feet above the floor. A sack filler was used consisting of a piece of pipe of galvanized iron about 8-inches in diameter, with a funnel top the pipe being a little longer than the sack. This funnel was placed in the sack, and the whole held under the spout of the bunker; enough ore was run in to fill the pipe to the throat, when the pipe was withdrawn leaving the ore in the sack. The sack was then sewn up and thrown on to a small chute leading to the top of the 3-rail tramway, where it was loaded into the car which took loads of nearly four tons. In the North Star a handful was taken from each sack as a sample, and the combined sample went to the assay office as a check on the shipment.

Outside of the hoisting engine mentioned there was no plant worth mentioning, the blacksmith shop being a log-house with a forge and bench, and a few ordinary tools, including pipe cutters and pipe wrenches. The fuel used was charcoal made from the dry trees spoken of, and was poor in quality, even when apparently well burnt. Later on coal was obtained from the Crow's Nest Pass. But before the railroad arrived all freight had to be hauled 188 miles to reach the mine from the nearest railway point, which made coal and coke cost from $75 to $100 per ton at the mine.

I regret that I can give no exact statistics of costs of work at the North Star, but as sinking No. 3 shaft was the only piece of work done continuously long enough to furnish figures of any value I will specify the labor and costs approximately. Two shifts were worked of two men each. The shaft being about 5 ft. by 8-ft. in hard diorite, the day shift was to hours and the night shift 9 hours. The night shift drilled all night and blasted

before going off shift; the day shift came on and mucked out the shaft, the engineer hoisting the muck. Generally one miner acted as topman, and the other shovelled, and they took turns. The bucket was an oil barrel, cut in half and ironed, and a bale put on. It took about 2½ to 3 hours to clean the shaft, and then the men drilled till about 3.30 p.m., and then blasted and hoisted out muck till quitting time, leaving the shaft clear for the night shift. Between whiles the engineer cut down trees for firewood, helped in the shop, repairs, or other odd jobs round the place. A man was kept who looked after the horse and did all teaming, etc.; he hauled in the felled trees to the engine house where a small circular saw attached by a removable belt to the engine was used to cut it up for the engine, and for domestic use. This horse was also used on a horse-whim to hoist out of a prospecting shaft on a neighboring property. The approximate cost for a week's work was then about as follows:

		Per ft.
Miners 4 x 7 = 28 days at $3.50	$98 00	$19.60
Engineer about 7 hrs. per day x 7 = 4.9 days at $3.50 per day	17 15	3 43
Boy about 7 hrs per week at $2 per day	1 40	28
Blacksmithing about 35 hrs. at $3.50 per day	12 25	2 45
Powder about 30 lbs., average at 25c	7 50	1 50
Candles, fuse, caps, etc., about	5 00	1 00
	$141 30	

Average distance driven 5 feet per week equals $28.26 per foot, exclusive of superintendence and outside charges. There was no timbering required except to fasten the skids to. It may be mentioned that the miners were not of the highest class, being weak in placing their holes, a weak point of most ordinary miners. It may be of interest to compare this cost with similar items in sinking a two-compartment shaft in Rossland, B.C., in somewhat similar rock, but where air-drills, compressor, etc., were used.

	Rossland.	North Star.
Drilling and mucking	$20 54	*$22 10
Miscellaneous supplies, etc., proportioned		
Timbering	15 73	
Hoisting	3 05	3 71
Blacksmithing	2 10	2 45
Surface labor	6 04	
Office	64	
Ventilation	1 44	
Pumping	7 02	
Superintendence	2 44	
	$59 90	

*Including powder, fuse and supplies.

Rossland total cost includes a lot of preliminary and surface labor, but drilling is fairly comparable with North Star and shows that often the advantage of air-drills is chiefly in speed. It is perhaps in order to give here an idea of how these costs are arrived at and kept track of.

The average college graduate in mining is not a trained business man, yet it is perhaps the most important part of a mining engineer's knowledge, this same business training. This cannot be too often urged on the engineer. The biggest ore body in the truest fissure ever discovered is useless unless it will pay. Business considerations then come first on the list. The engineer who can make $2 ore pay by extracting 75% of its value is a more valuable man than he who makes a losing proposition of it, even though he has the knowledge and skill to extract 90% of the value of the ore. Many a report of the average so-called expert shows a lack of understanding of the business value of the proposition. In managing a mine it is necessary then to keep close track of all expenses, and the manager should know whether his costs are high or low, whether his miners are using too much powder for the work done, and a multitude of similar items require constant watching. It is evident that a good system of keeping and tabulating costs should be observed, and I would advise every student to post himself on this point before leaving college if he intends going into mining at least. There is some literature on this subject doubtless in the Trans. of A.I.M.E., and the E. and M. Journal, and elsewhere; one or two by John E. Hardman in the Can. M. Review during the past three years will be found to be practical and simple.

The system must be suited to the mine. A large mine with many men and different kinds of work, as stoping ore, development, dead work, and so on, will require a more elaborate system than a small mine. In the Nickel Plate in Rossland, and the North Star mines the systems were simple and suited to the ordinary small mine, so I will describe them briefly, not holding them up as ideals but giving an idea as to how it was worked in practice. In the North Star where supplies formed a small and easily watched item three books were kept. A large time book with each man's name and his daily time with columns at the end for total time, rate, amount, deductions, and net amount due, being practically a pay roll. A small time book was kept with a page for each piece of work as, No. 3 shaft, north drift, hoisting, blacksmithing. Every day each man's total time was marked in the large book, and the subdivision in the smaller book the man's name occurring often in several places in the smaller book. At the end of the month or the week as wanted (generally a labor or approximate report every week and detailed one every month), each book was made up, and the totals should agree. At the month's end the pay-roll was taken from the large time book. In calculating costs the gross amounts on the pay roll, and not the net are used, as the deductions for board, etc., have practically nothing to do with the mine directly. The third book was an ordinary long day book; in this a record of stock on hand was entered at the beginning of the month, and all supplies received during the month were entered, and all supplies issued were also entered. At the end of the month stock was taken again, and the difference between this and the previous stock list plus supplies received gave the supplies used. This should agree with the items of supplies issued during month, but as it is difficult to weigh out powder, for instance, accurately, any small discrepancies were proportioned to the different drifts. In this way the accounts always balanced. The monthly statement showed the cost for each piece of work of superintendence, mining, etc., and supplies, each specified, with the distance each drift, etc., had progressed, and the total cost per foot, and the cost per foot of each item. The costs could be readily compared and the lazy men discovered.

The cookhouse supplies were kept separate and their cost, and the $1 per day per man board off the pay roll showed the profit or loss from this source.

At the Nickel Plate in Rossland the system was also quite simple, though supply accounts were more detailed. Time books were kept as at the North Star, while for each piece of work a separate page in the small time book showed the subdivision as mining, mucking, timbering, time putting in air pipe, etc., and occasionally an hour or two of some expert mechanic's time. There were two supply books kept. In one every invoice of goods was entered, not from the invoice, but as checked on receipt, all deliveries being watched closely to see that quantity and quality were right. These entries served to check the statements rendered by the dealers, and to keep a record of prices. A private price book was also kept in which the price of everything with date and place of purchase and other particulars were entered for the sake of reference. The second supply book was entered from the first one, but here everything was subdivided into different heads, as fuel, powder, etc. In this was entered at the end of each month, stock on hand of each article under its proper heading and each invoice was carefully entered, item by item, under appropriate headings. At the end of the month stock on hand was subtracted from the totals, giving the net amount used. In practice this book would be usually subdivided, or separate books of this kind kept for each drift, making a separate account for each drift. I have made a rough draft of the monthly report blank used at the Nickel Plate, where all the work except shaft was grouped in one. In practice it would be better to make out one for each separate drift or piece of work. In the remarks column daily diagrams of the face with assays and distances from nearest survey point, and other remarks as to character of country rock, ore, vein, etc., can be entered with anything else that may be useful for reference, etc. A continuous file of these with a map from a good survey gives an extremely good record of the mine, and is of great value for instance in a sale of the mine, and for studying the geology, etc., of the deposit. All permanent plant as compressors, rails, buckets, etc., is kept separate, and the cost can be subdivided or charged to capital account or any other way you like, accord-

CONTENTS OF THIS NUMBER:

	PAGE
Automatic Gas Machine	xvii
Adams, Dr., as Successor to Dr. Dawson	254
Belleville Water Tube Boiler	253
Calorimeter Trials For Moisture in Steam	256
Canadian Mining Institute	257
Canadian Northern Railway	266
Catalogues, New	267
Dials Graduated on Tools	265
Engineering Ethics	254
Electric Flashes	269
Fergie, Chas	261
Industrial Notes	268
Libraries in Machine Shops	254
Logan, R. S.	272
Mineral Production of Canada	iii
Machine Tools, Graduated Dials on	265
Marine News	271
Mining Matters	272
North Star Nickle Plate Mine	261
Paint For Iron Work	xxxiv
Personal	271
Railway Matters	270
Sewage Disposal	265
Solway Process of Repairing Copper and Nickle	xxxiii
Shawinigan Water and Power Co's Plant	249
Stevens' Guns and Rifles	272
Turbine Steam	xxxiv

ing to circumstances. It is difficult in practice to keep accurate account of many of the items, such as candles for example. It is customary to give miners three candles (½-lb.) per shift, and muckers four. Thus the cost can be pretty well obtained by proportioning according to the time book. At the Nickel Plate each man was required to mark on a pad in the powder thaw-house, how many sticks he used, and where it was used; every day the marked slip was torn off, dated and filed till the end of the month, when the powder used was proportioned according to the sticks used. Other supplies were kept track of this way or charged as issued from storehouse to best suit the circumstances.

As the hoist used steam from the compressor boilers it was usual to make an expert guess at the percentage used by the hoist. This was usually small, from 3 to 5%. Thus it will be seen that eternal vigilance as well as a good simple system is necessary to keep good cost accounts, but the trouble and time are well repaid by giving the superintendent a chance to discover leaks and losses, and to bring the mine to a high state of efficiency. In conclusion I might say a brief word or two about the assaying of the North Star ores. The charge used for both galena and carbonate ore in the fire assays for lead consisted of a flux of the following composition:

Pot. carb., K_2CO_3, 16 parts

Sod. bicarb., $NaHCO_3$, 16 parts.

Flour, 5 parts.

Borax glass, $Na_2B_4O_7$, 8 parts.

Five grams of ore were mixed with 20 grams of this flux in a 5 or 10 crucible, and 20 grams more flux added as a cover, with two or three nails for the galena ores. This gave slightly higher results than fusing with cyanide, and a much more satisfactory slag, while with the carbonates the cyanide often gave no button at all.

It was usual to cupel the lead button and weigh the silver bead, thus the lead assay and the silver assay by the ordinary scorification process formed some check on each other, sufficient for ordinary mine samples.

McGILL MINING COMPANY, MONTREAL, CANADA.

Statement of costs Mine, month ending 1900. (No. 6 sheet, 200 ft. level, east.)

SUMMARY.	TOTAL AMOUNT.	COST PER FOOT.
Total labor		
Total supplies		
Total		
SUPPLIES.		
Powder		
Fuse		
Caps		
Candles		
Fuel		
Blacksmith coal		
" supplies		
Drill supplies		
Lubricants		
Nails		
Lumber		
Timber		
Shovels		
Iron		
Steel		
Miscellaneous		
Total		
MACHINERY AND PLANT		
Pumps		
Engines		
Ore buckets		
Tools		
Cars		
Cables		
Miscellaneous		
Total		

LABOR.	TOTAL AMOUNT.	COST PER FOOT.
Foreman		
Shift boss		
Machine men		
Hand miners		
Machine men (shaft)		
Engineer (compressor)		
" (hoist)		
Blacksmith		
Blacksmith helper		
Pump men		
Carpenters		
Muckers		
Timbermen		
" (helpers)		
Timekeeper		
Topmen		
Laborers		
Machinists		
Master mechanic		
Etc.		
Etc.		
Etc.		
Total		

If desired, columns can be ruled here for "time" and "rate per day."

On this side of report statement of work done, special difficulties encountered, strikes of rich ore or barren ground, daily diagrams of the face or faces of work, assays and any other information desired to be recorded can be entered.

Superintendent.

—At the annual "At Home" of the Canadian Association of Stationary Engineers (Toronto No. 1), there was a large gathering of members and their wives and sweethearts, who thoroughly enjoyed the reunion. A bountiful supper, dancing and pleasant conversation made the time pass rapidly. Too much praise cannot be given to Chairman C. Moseley and Secretary-Treasurer John W. Marr for the admirable manner in which they carried out the arrangements made by the committee by which so many enjoyed themselves.

SEWAGE DISPOSAL.*

BY R. S. LEA, MA.E., M. CAN SOC. C.E.

It is a remarkable fact that, while Damascus, Nineveh, Babylon, and many other ancient cities of the old world, were provided with abundant artificial water supplies and extensive systems of sewerage, it is only within the last half-century that the drainage system of London, the greatest of modern cities, has been brought to such a condition of efficiency as to permit of its general use in the removal of household waste.

During the long, dark period of the Middle Ages, which succeeded the dismemberment of the Roman Empire, sanitary provisions were almost entirely neglected, the narrow streets and alleys of the crowded cities were made the receptacles for the waste products of the teeming populations, and bodily filth even came to be regarded as a mark of holiness of mind. The penalties for these ignorant violations of natural laws followed in the form of terrible plagues and epidemics, while the unfortunate misconception of the nature of the offence suggested no more effective remedy than the wearing of sackcloth and ashes.

In London, during the seventeenth and eighteenth centuries, rough drains were constructed for the removal of surface water; but for the household waste or sewage proper the gutters, occasionally supplemented by pits or cesspools, remained the only method of disposal. In later years, as the methods of construction improved, the storm-water drains were sometimes used for sewage as well; while earth closets and various pail systems for direct removal began to be substituted for the vaults and cesspools. Meanwhile an artificial water supply had been introduced, and in 1847 the drainage system had been improved and extended to such a degree that it was made compulsory to discharge into it all sewage of every description. This was a return to the water carriage system of the ancients, in which the liquid wastes serve as a vehicle for the removal of the solid, with manifest advantages from an economical as well as a sanitary point of view. Yet, through a desire to utilize the manurial qualities of the excremental matter, many places continued for several years to employ some form of direct removal, without the admixture of water, for this portion of the sewage. But the objectionable features unavoidably connected with such methods, together with the increase in the number of public water supplies, soon tended towards the general adoption of the cleanly and efficient water carriage system, which, in America at least, may now be said to be almost universal. The assumption that such is the case will therefore be made in the further discussion of the subject matter of this paper.

Having provided the drains for its collection and transportation to some distant point, the first and most natural method of disposing of sewage in this highly diluted form was to turn it into the nearest body of water; and this was usually done without much regard to its volume. This system, while generally proving quite satisfactory to the community employing it, very soon began to develop into a nuisance for many of its neighbors, and as the construction of drainage systems became more general, it was soon evident that there was a limit to the quantity of sewage which could be disposed of in this way. Not only did many of the rivers soon become unfit for sources of water supply, but some of the smaller ones were practically becoming converted into large open sewers, disgusting in appearance as well as dangerous to health.

The small streams, dense population, and extensive industries of England, rendered her particularly liable to suffer from this condition of things. A Royal Commission, appointed to enquire into the question of stream pollution, made its first report as early as 1870, and in 1876 the Rivers Pollution Bill was passed, making it compulsory to purify sewage by some kind of artificial treatment before discharging into a watercourse. The passage of such an Act naturally led to the appearance of a great number of so-called "processes," patented and otherwise, for the treatment of sewage. It also had the effect of stimulating the investigation by scientific men, into the nature and constitution of the particular substances which gave to sewage its offensive and dangerous character.

This was a period of remarkable progress in the science of biology and organic chemistry. The processes of fermentation and the decomposition of organic matter were shown to be, under some conditions at least, dependent upon the action of living organisms, and not purely chemical, as was previously thought to be the case. Further investigation has proved this to be true, under all conditions and circumstances. The ideas and theories brought forward were soon put to practical test in the construction of a number of working plants, and as the studies and investigations have proceeded the results from these works have been of the greatest assistance in pointing out the direction in which the researches should be pursued.

In France and Germany, the subject has been developed along the same lines, but in America the necessity for such action was at first by no means so evident, by reason of the relatively sparse population and the immense size of the rivers and lakes. Nevertheless, in some of the New England States, the conditions began to be approximately similar to those common in Europe, and the problem of preventing stream pollution had already occupied the attention of the legislation of some of these States, notably Massachusetts, previous to 1887, when the latter State undertook the well-known series of experiments which have since been carried on under the direction of its Board of Health. As a general thing, however, the matter was given little consideration. Occasionally, when a water supply became seriously threatened, the subject was given a certain amount of discussion, but the tendency was, in most cases, to look upon the matter as an indication of the necessity for a new water supply rather than for special treatment of sewage, and to regard the pollution of rivers in this way as rather in the natural order of things.

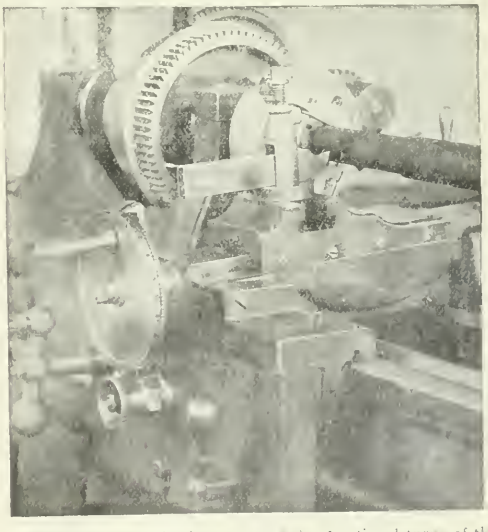
(To be continued).

* A paper read before the Canadian Society of Civil Engineers.

GRADUATED DIALS ON MACHINE TOOLS.

In the present stage of machine tool development it seems strange that the question of the accurate setting of cutting tools has not been more seriously considered. In the case of the milling machine this has been cared for, but by means of dials, which are altogether too small; requiring a magnifying glass to decipher them, and in some cases the dials being placed in some position where it is almost impossible to see them. In the case of the lathe, planer and shaper this has been almost wholly neglected, and only a few instances can be found, one with a means for measuring the movement of the cutting tool when making adjustments.

An intelligent workman will of course know the pitch of the screw by means of which the cutting tool is advanced, and



will calculate mentally the movement for fractional turns of the handle, and guide himself by the position of the handle in making adjustments; now why not go a little further and incorporate in the machine an accurate means for this very adjust-

ment. Quoting from an experience of several years with machines equipped as shown in the accompanying cuts, it is safe to say that no other improvement, involving so little expense to inaugurate, will result in so much profit. Anyone who has ever operated a tool on anything in the nature of fine work knows well that considerable time is lost, not to mention the amount of skill and patience required in merely finding sizes by the regular "cut and try" method. Where a workman starts in to size a piece of work to a fixed gauge, he finds himself groping in the dark until the final point (when the gauge goes over), and this is sometimes the fatal point, if it goes over too loose; and work which is under size is generally a total loss. Now with the proper means in the hands of the workman this can be almost always avoided. With a micrometer caliper he can find the exact size of the work after taking a trial cut, and by means of the graduated dial on the machine accurately set the tool to cut the exact size required. Lathe work may be roughed down to size in the regular way; then measure with the micrometer, make calculation and suitable adjustment by dial, and feel safe in going ahead for size first time trying. These dials are useful for other purposes, such as thread cutting, testing truth of work, setting lathe for turning tapers, and numerous other calculations.

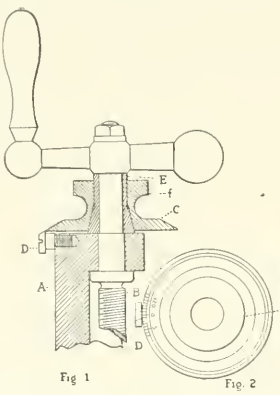


Fig 1 Fig. 2

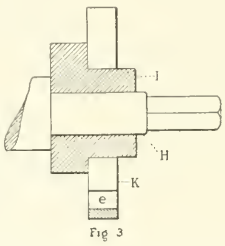


Fig 3

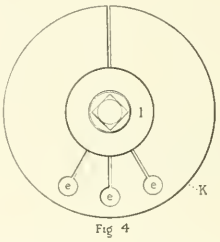


Fig 4

A shaper recently purchased was provided with a graduated hub on the down screw, about 1⅛-in. diameter, divided in 125 divisions, which were so fine, when the ram was running, they could not be seen at all. This point spoiled its usefulness. In Fig. 1 is shown how it was fixed. The little sleeve E was formerly graduated on its lower end; this was removed and turned tapering, as shown, and the dial C fitted to it. The part f is coarse knurled, and the taper is such that it does not stick hard, but can be turned by the fingers on the sleeve E. This dial is 2¾-in. diameter and is graduated to read in thousandths of an inch on its upper beveled edge, a part of these graduations being shown in Fig. 2, D in both Figs. 1 and 2 being the pointer, which as shown in Fig. 1 is simply a screw, tapped into the slide A with one edge of the head filed to match the edge of dial, and a line cut to match with the lines on dial as shown. This dial is easily read while the machine is running, and is considered one of the best features of the machine.

Figs. 3 and 4 show the dial fitted to the horizontal feed-screw. H is the end of feed-screw squared on end for crank. I is hub on feed ratchet and K dial, which is held on hub I by its spring fit. The holes e-e-e and saw cuts are made to give it proper spring. The diameter of hub I in this case is 1½-in., and the hole was bored in dial .005-in. smaller. The outside diameter of dial is 4½ in., and is graduated in 250 divisions, with every fifth line extended and numbered. The pointer is made of flat bar steel, bolted to saddle and bent to suit, with edge beveled and line cut to match graduations of dial.

This makes a very satisfactory dial. For lathes, on cross-screw, we make the dial take the place of the crank, as shown in the half-tone cut. The quill between the apron and old crank has a straight seat turned upon it, and on this the zero pointer is mounted and held by a split grip. Of course these machine feed screws are not very accurate and so dependence cannot be placed on them for long adjustments. The point is merely for sizing a matter of 5 to 25 thousandths.

On machines provided with hand wheels the rim of the wheel can very often be graduated, and thus serve in itself as a large dial. The Canadian Engineer is indebted to the J. T. Slocomb Co., of Providence, R.I., for the use of the cuts shown in this article. Their object was simply to help their fellow-workers to make better use of machines in their shops. They do not manufacture these graduated dials but they will be pleased to supply any further information our readers may require.

CANADIAN NORTHERN RAILWAY.

As the political aspects of the recent contract between the Manitoba Government and Mackenzie, Mann & Co., of Toronto, have been the subject of a good deal of discussion, our readers will be interested in knowing something of the scope of the undertaking. This new railway system is made up of a series of links already constructed which, when the missing links are completed, will probably be extended westward from the present eastern terminus at Port Arthur till it reaches the Pacific coast at Fort Simpson, a fine natural harbor, 487 miles north of Vancouver.

The company started by buying the Port Arthur, Duluth & Western, which runs southwest along the Lake of the Woods to the boundary of Minnesota, about 85 miles, of which 24 miles is in operation, running from Port Arthur through a mineral country. From Stanley, under the charter of the Ontario & Rainy River Railway, the company are building west to Fort Francis, at the head of Rainy River, through a rich agricultural and well timbered country, estimated to contain in the Rainy River Valley alone, not less than 750,000 acres of good arable land, while the total area of the district, regarded as fit for farming and stock raising, is estimated at 2,000,000 acres. The Rainy River also runs for about 80 miles through a rich alluvial district, with tracts of white and red pine all through it, interspersed with some of the richest mineral ranges in the world; abounding in gold, silver, iron and copper. Five millions of dollars worth of silver alone has been taken from the mines along the shores of Thunder Bay; the output of gold in 1898 being 14,189 oz., valued at $237,404, the whole output of the province for the said period being valued at $271,906. The company are now making arrangements to ship copper ore from the Round Lake copper district, as well as iron ore from the Atikokan iron range in the Mattewan iron country, so celebrated for its deposits of a Bessemer ore, averaging 50 to 60 per cent. metallic iron. The company have, by arrangement with the Manitoba Government, made a special rate on wood products, which will materially assist the pulp industries, one of the future big industries in this part of the country, owing to the many valuable water privileges available for power generating purposes. It is 200 miles from Stanley to Fort Francis, of which 125 miles is under construction; the country being mostly mineral to Fort Francis, and from there to the mouth of the Beaudette River it is a fine agricultural section. The total length of line from Port Arthur to Winnipeg is 440 miles, 43 miles of which runs through the State of Minnesota, south of the Lake of the Woods. The charter for this section of the line also includes the right to build an extension to Duluth. The Ontario Government granted a subsidy to the Ontario & Rainy River Ry. of $1,000 per mile for 205 miles to Fort Francis, and for 75 miles to the mouth of the Rainy River, and it is to be finished by July 1st, 1901. At War Road the Minnesota and Manitoba again reaches the boundary of Manitoba, and connects with the Manitoba and Southeastern, another finished link in the chain. This road runs into Winnipeg, through a fine agricultural and well timbered country, which practically supplies all the wood fuel for that city. Along this line are some very thriving

villages, mostly peopled by French Canadians, and a large settlement from the northwestern states. The principal places are Sprague, Marchand, La Broquerie, St. Anne, Dutresne, Lorette and St. Boniface. The northern terminus of this link, which is 108 miles long, is Winnipeg, and here the company have let to Kelly Bros., of Winnipeg, the contract for the sub structure for a fine bridge over the Red River. They also contemplate building a million dollar hotel and depot. Winnipeg will also be the headquarters of the system, whose executive head is Hugh Sutherland, of Winnipeg. On the Manitoba and Southeastern link, an extension is to be built from a point between Marchland and Winnipeg, westward, via Carman and Belmont, to the western boundary of Manitoba; also an extension from the same line from a point between Carman and the Red River, northwest to Portage la Prairie, and from a point west of Carman through the province of Manitoba south to the international boundary. Another extension is proposed from a point on the line between Carman and the Red River, south to Emerson, thence east to a point on the main line between Vassar and Sprague; also a branch from a point 10 miles north of the company's line between Winnipeg and St. Anne, south to the boundary. All these branches will run through the most settled part of the rich farming country of Southern Manitoba. Starting from Winnipeg towards the Pacific coast, the Canadian Northern absorbed the Lake Manitoba Railway and Canal Co, through the Swan River district, formerly the Dauphin Route, peopled by Galicians, Doukobors, Swedes and hardy Canadians. It runs through a section of Northern Manitoba, which during the past two years has been producing harder wheat with larger yield than in other parts of Manitoba, owing to the dryer weather, which gives better harvesting. The company had running powers from Winnipeg, northwest over the Northern Pacific to Portage la Prairie, 55 miles; and over the Manitoba and Northwestern, from Portage la Prairie northwest to Gladstone, 30 miles, but the leasing of the whole of the Northern Pacific Company's lines in Manitoba when completed, will put the Canadian Northern in better shape to push on out west. From Gladstone, the terminal point of the Manitoba and Northwestern, the old Dauphin route, as it was formerly called (now under the control of the Canadian Northern), is completed to Red Deer River, 279 miles, through Glencairn, Laurier, Ochre River and Dauphin to Sifton. From Dauphin the Gilbert Plains branch, 21 miles west, is finished; and another, the Winnipegosis branch from Sifton Junction, 27 miles west to Lake Dauphin, is completed. From Swan River the road is being rapidly pushed northwest to the Saskatchewan River, and on towards Prince Albert and Edmonton, at the rate of about 100 miles a year, the company getting a subsidy of $320,000 for 100 miles from Swan River, from the Dominion Government. This portion of the line runs through the fertile valley of the Saskatchewan, which is said to produce the finest wheat crops of any section in the northwest. The Government has also given a subsidy for 50 miles west of Edmonton, with the right of way through the Yellow Head pass over the Rockies. From here the road will descend the upper Fraser valley, through the rich Cariboo mining district, to the ocean at Fort Simpson, B.C. Application has been made to the Dominion Parliament to build an extension from the end of the 40 miles built by the Winnipeg Great Northern, to the village of St. Laurent, thence to Oak Point, on Lake Manitoba, north to Grand Rapids on the Saskatchewan River; and application for another from a point between Oakland and Macdonald, west to Brandon, thence to the boundary near township 15 or 16, thence northwest to a point on the company's line northwest of Battleford. And another branch from the International boundary line between ranges 1 and 6, west to the town of Gladstone; with branches from points on the main line to Carman and Holland, and the towns of Carberry and Neepawa, and a branch line east from Morden to connect with the Canadian Northern at some point between township 6 and the international boundary line, and to some point on the western boundary of the province.

Mackenzie, Mann & Co., recently bonded the entire line for $3,500,000 in England. West of Winnipeg the company has a land grant of 6,400 acres to 12,800 acres per mile; making a total of 2,455,466 acres; and in Manitoba the bonds are guaranteed by the Provincial Government, both principal and interest, at the rate of $8,000 per mile, which may be increased to $10,000.

The latest and most important step in the company's operations is the acquisition of the Manitoba lines of the Northern Pacific Railway on the terms announced last month by the Provincial Government.

NEW CATALOGUES.

The following are among the new catalogues received. Copies will be sent to readers of The Canadian Engineer on writing to the addresses given:

Arthur Koppel, 68 Broad street, New York, catalogue of materials of all kinds for narrow gauge railways.

General Compressed Air House Cleaning Co., St. Louis, Mo., describing apparatus for a dustless method of house cleaning by compressed air.

International Correspondence Schools, Scranton, Pa., describing the courses of technical instruction offered by these schools

Adam Weber Sons, 633 East 15th street, New York, chimney designers, describing chimneys built of their perforated radial blocks.

Spramotor Co., London, Ont., describing their method of painting and whitewashing by a spraying machine, also method of spraying fruit trees.

The Julian d'Este Co., 25 Canal street, Boston, Mass., manufacturers of the Curtis engineering specialties, a new series of catalogues describing their steam pressure regulators, steam separators and traps, damper regulators, pump pressure regulators, etc.

New Process Raw Hide Co., Syracuse, N.Y., describing noiseless gears made of raw hide.

American School of Correspondence, Boston, Mass., describing courses of instruction in mechanical, steam and electrical engineering; also terms of free scholarship.

E. M. Dart Mnfg. Co., Providence, R.I., describing flanged unions, elbow unions, stop cocks for steam, gas, water, oil, etc.

Union Steam Pump Co., Battle Creek, Mich., describing the Moore steam pump and the Burnham steam pump for all purposes, giving several useful tables. Darling Bros., Montreal, Canadian agents.

The B. F. Sturtevant Co., Jamaica Plain Station, Boston, describing the Sturtevant engine for electric light and other work where fine speed regulation is called for. Also from the same firm, 3rd edition of their catalogue of steel plate fans, with several tables referring to air pressures under varying conditions

The Ballard Electric and Machine Co., 6 Adelaide street west, Toronto, describing electrical machinery and supplies made and dealt in by the firm.

Kieley & Mueller, West 13th street, New York, manufacturers of steam specialties for heating and power installations, such as regulating valves, back pressure valves, exhaust valves, steam traps, grease and oil traps, grease extractors, steam separators, pump regulators, automatic water feeders, pump governors, damper regulators, etc. Canadian agent, R. Gemmel Miller, jr., Montreal.

Babcock & Wilcox, 202 St. James street, Montreal; handy pocket diary containing tables and useful memos.

Industrial Notes.

A new match factory is to be started at Milltown, N.B.

T. D. McFarlane is about to start a factory for galvanized iron works in Ottawa.

It is reported that the Cleveland Sawmill & Lumber Co., will erect sawmills at Sarnia, Ont.

George E. Corbett, of Annapolis, N.S., is sanguine of being able to form a company to establish iron works there.

The Shaw Milling Co. are building a flour mill on the site of the Chaplin saw-works, recently burnt at St. Catharines.

Willis Chipman, C.E., Toronto, is preparing plans for a sewage system for Sault Ste. Marie to be installed during the coming summer.

The bonus to the McKinnon Dash & Hardware Co., to enable them to extend their works, has been carried at St. Catharines.

Henry R. Lordly, of St. John, N.B., has been visiting Hamilton, enquiring as to the advantages of the city as a site for a factory for ball bearings and drop forgings.

Evans, Coleman & Evans, Vancouver, B.C., will erect large cement works at Mission City, B.C., at a cost of $200,000. A marble quarrying and polishing plant will also be established at the same spot.

The Pontbriand Co., of Sorel, Que., are now installed in their new premises, and are manufacturing marine engines and boilers, feathering wheels for steamers, waterworks supplies and cheese and butter factory supplies.

The case between the American Stoker Co. and the General Engineering Co., of Ontario, is to be taken before the Privy Council in England, on the question of the interpretation of section 8 of patent law.

The granitewear plant of the Ossekeag Stamping Co., at Hampton, N.B., has been sold under liquidation order, the purchasers being A. E. Kemp, Toronto; J. D. Davidson, Montreal, and Col. Gartshore, London, Ont., the reported price being $80,000.

Tenders are being called for the building of a steel bridge over the Humber River at Weston, near Toronto, to replace the Eagle bridge, at a cost of about $10,000.

A large overhead bridge at the foot of Yonge street, Toronto, crossing the railway tracks, is about to be erected. City Engineer Rust estimates the cost at $125,000.

The James Cooper Mnfg. Co., of Montreal, have began the erection of an extensive new iron foundry at Lachine, for mining machinery. The works will cost $250,000, and employ 300 hands.

The bylaw granting a bonus of $10,000 to the Canadian Steam Carriage Co., having been carried at Port Dover, the electric light company's building there is being fitted up as a factory.

It is said the New York capitalists will start this spring on the proposed pulp mills at the Grand Discharge, of the Saguenay, referred to in a recent number. It is stated that the mills will have 60 grinders and turn out 600 tons of pulp per day.

The Real Estate Owners' Association, of London, Ont., are moving to get the Ronald fire engine works brought there from Brussels, Ont. It is proposed to form a new company and make fire ladders, steam rollers and water meters, as well as fire engines.

Selby & Youlden, Kingston, Ont., have been appointed Canadian manufacturers of the Donovan hand car, a hand car having pressed steel wheels and roller bearings, the same principle of construction being applied to trucks for mining purposes, etc. An extension to the shops is being made for this special work.

The bridge connecting Richmond and Melbourne,, Que., and costing $46,000, was wrecked in a freshet on the 7th inst. The damage to the town will also be great. At Fredericton, St. Stephen and other places in New Brunswick serious losses were also caused by floods. There have also been damaging washouts on the N.S. Central Ry., and along the Musquodoboit Valley of Nova Scotia.

The Engineers' Club, of Toronto, reports 28 new members during the past month. At the last meeting in March an interesting account of Mr. Clergue's operations at Sault Ste. Marie was given by T. J. Kennedy, the chief engineer of the works. At the meeting on the 2nd inst., an account of engineering and surveying in the Yukon was given by L. B. Stewart, of the School of Practical Science, being reminiscences of his recent trip there.

A new society has been organized at London, Ont., under the name of the Society of Engineering and Applied Science. It is intended to follow the lines laid down by the Engineers' Club of Toronto. The inaugural meeting was addressed by F. E. Leonard, M.E., Prof. Bowman, F. Henry, F. W. Farncombe, C.E., Prof. Harrison, F. W. Merchant, Dr. Wolverton, F. W. Matthews, Principal Kirk, Dr. Cl. T. Campbell and others. Officers were elected as follows: President, Prof. Bowman; vice-president, F. W. Merchant, M.A.; secretary, F. W. Farncombe, C.E.; treasurer, R. Kirkpatrick; organization committee, Messrs. Merchant, Hunt, Mitchell, Leonard, Bowman, Henry, Sifton, Campbell and A. W. White.

The Ontario legislature has voted $200,000 for further equipment to the applied science departments of Toronto University and the School of Practical Science. Of this sum, $50,000 is to be advanced at once to make a start on a new building, three or four stories high and several hundred feet deep, extending from College street north, and to make room for which the old technical school building will be demolished. The design for this building will be open to the competition of Canadian architects; and when completed will be occupied by the departments of applied chemistry, geology, mining and metallurgy. It will be equipped with modern machinery and apparatus; and the transfer of the chemistry departments from the present School of Science building will leave room for the much needed extensions and developments in the electrical and mechanical branches of the School of Science. Prof. Galbraith will start on a tour of investigation abroad to gather information on the equipment of applied science departments of other universities.

The plant of the Abbott-Mitchell Iron & Steel Co., Belleville, will be put up at auction on the 23rd inst.

The biennial convention of the International Association of Machinists will open in Toronto, June 3rd, and continue for a week or ten days. Several hundred delegates are expected.

The Canadian rights of the O'Brien clutch pulley are advertised for sale in another column. Full particulars may be had of M. F. Kelly, or Thos. J. O'Brien & Co., Cairo, Ill.

The Granby, Que., Enamel Works propose to remove their factory to St. John's, Que., for a bonus of $20,000, and the cost of moving. They propose to organize a company and employ 50 to 75 hands in manufacturing enamel baths.

J. H. Sherin, Lakefield; S. Henderson, J. E. Knox, Mrs. M. A. Knox and T. H. Knox, Toronto, have been incorporated as the Wrought Iron Wheel Co., Ltd., to manufacture, sell and trade in metal wheels, waggons, vehicles, agricultural implements, etc.; capital, $10,000; head office, Toronto.

D. Porter, R. M. Fisher, S. A. Perry, D. M. Jermyn, J. Symon, Wiarton; J. Rowland, D. Robertson, Walkerton; J. E. Murphy, Hepworth, have been incorporated as the Dominion Portland Cement Co., of Wiarton, to manufacture Portland cement and peat fuel; capital, $250,000; head office, Wiarton.

Incorporation is being applied for by the John Bertram & Sons Company, of Dundas, to manufacture and deal in machine tools, machinery, pulp and paper machinery, and operating by steam, water or electric power. The proposed capital is $300,000, and the applicants are John, Alexander, Henry, James and Thomas Bertram.

The Misses Dow, of Montreal, have given $60,000 to found a chair of political economy in McGill, and Sir William C. Macdonald has added $150,000 to his numerous other benefactions to the same institution. This latest gift will be used to further equip the chemistry, physics and mining departments, and the endowment of a chair of botany.

The Montreal office of the Beardmore Belting Co., which in consequence of the great Montreal fire was moved temporarily to 12 Lemoine street, is now established at 26 St. Peter street, not far from their former premises. Two days after the fire this firm had a full stock of all sizes of their best grades of belting to supply their Montreal customers.

In the beet root sugar bonusing bill brought up in the Ontario Legislature two changes were made in committee. Instead of setting apart $75,000 a year for three years, a lump sum of $225,000 was appropriated, and the bonus is to be half a cent a pound for the first and second year of factory's production, and a quarter of a cent a pound for the third year.

The General Fire Equipment Co., of Toronto, of which Wilson Phillips is manager, are equipping a number of factories with their automatic sprinklers which are giving general satisfaction. A striking instance of the benefits of these fire prevention devices was given the other day at Lachute, when the paper mills of J. C. Wilson & Co. were saved from destruction by the automatic sprinklers.

The stationary engineers' licensing bill is not likely to pass the Ontario Legislature this session, but provision is being made in the factory act amendments for the compulsory insurance or inspection of boilers; also for the storage of inflammable material in buildings separate from factories, and for putting the onus of providing fire escapes on the owner and not the tenant of a factory.

In order to protect the trade and consumers against imitations of their water purifying chemicals, Geo. W. Lord, of Philadelphia, adopted a copyrighted package in the shape of a handsomely lithographed fac-simile of a barrel, and all genuine Lord's boiler compounds will be packed hereafter in packages bearing their copyrighted label. The above announcement will be of interest to steam-users in Canada as many of them have bought and paid for boiler compounds which were represented as "Lord's," or the same as "Lord's," but which proved worthless. D. Sleeth, sole agent for Canada, 13 St. John street, Montreal, carries in stock half barrels and barrels of the numerous formulas, which are manufactured specially for various waters, and if anyone troubled with boiler scale will send him a sample for analysis he will quote prices on chemicals which clean boilers and keep them clean.

The Keewatin Power Co. have obtained from the Ontario Government, a concession of pulp timber on 60 square miles of land along streams tributary to the Lake of the Woods, on condition that the company spends $1,500,000 within three years in the erection of pulp and paper mills at its water powers at Funnel Island, Rainy River.

Fire in a business block in Niagara Falls, Ont., recently destroyed the offices of Charles H. Mitchell, C.E., hydraulic engineer. A portion of the contents, consisting of valuable instruments, books and fixtures were burned, and many valuable plans, etc., in the drafting room were destroyed by water, which will require to be reproduced. Loss upwards of $2,000; partially covered by insurance.

The Applied Science Society of the McGill University have elected the following officers for the session 1901-02: President, C. M. Campbell, '02; vice-presidents, J. N. Hicks, '02, and H. P. Borden, '02; secretary, Jas. C. Ross, '03; treasurer, O. Hall, '03; second year representatives, E. J. Carlyle, '04, and G. O. McMurtry, '03; reporters, H. Biggar, '02; F. E. Sterns, '02; C. Rowlands, '03, and Egleson.

Electric Flashes.

The Chambly Water & Power Co., started again to deliver power to Montreal on the 15th March.

The Jones & Moore Electric Co. have placed a 20-h.p. motor in C. Wilson & Son's new foundry, Toronto.

The T. Eaton Co., Toronto, have purchased four additional electric motors from the Jones & Moore Electric Co.

An electric car system connecting with Montreal via the Victoria Bridge is being discussed by the council of Longueuil.

Alex. Hobson, of Beaverton, Ont., proposes to build an electric railway from his peat works to the G.T.R. station at Beaverton.

Walter White, son of Hon. A. J. White, of Halifax, has been appointed manager of the Sydney Electric Light Company, of Sydney, N.S.

The Dundas Electric Company's power-house, at Webster Falls, was recently destroyed by fire, but will be rebuilt as soon as possible.

A fire starting from electric light wires did some $8,000 worth of damage to the Lawry pork packing house in Hamilton, Ont., recently.

Richard Shopland, formerly with the London, Ont., Electric Co., is now chief engineer of the Sandwich, Windsor & Amehrstburg street railway.

Municipalities between Simcoe, Berlin and Goderich are being approached for the right of way for an electric road from Port Dover to Goderich via Berlin.

The Rodney, Ont., Gas & Water Co., has been incorporated with a capital stock of $10,000. Provisional directors: S. B. Morris, N. S. Lusty and E. A. Hugill, Rodney.

The Kemp Manufacturing Co., Toronto, have installed a 10-h.p. motor in their wood working department; the machine was manufactured by the Jones & Moore Electric Co.

H. W. Garth, L. J. Tarte and J. O. A. LaForest, Montreal, are applying for incorporation as the Laval Electric Power Co., to produce electricity for lighting, heating and motive power; capital, $100,000.

A Tremblay, E. Oueller, Herbertville, Que.; and Wm. Larouche, Dorval, Que., have applied for incorporation as the Herbertville Electric Co.; capital, $6,000, head office, Herbertville, Quebec.

The Quebec Suburban Electric Railway Co. is aplying for incorporation to construct an electric line from Quebec along the south shore of the St. Lawrence in the counties of Levis and Lotbiniere.

The Mayor, D. Hooker, Wm. Beattie, R. E. Hamilton G. H. Berger and W. J. Best, have been appointed by the citizens of Welland, Ont., to enquire into the cost of installing a municipal electric light plant there.

The Dominion Coal Company will build an electric tramway line between Glace Bay and Sydney.

The St. Paul Land & Hydraulic Co., Montreal, has applied for incorporation; capital, $150,000; to develop hydraulic power, etc.; applicants include W. R. Miller D. C. S. Miller and J. H. Wallace, Montreal.

The Suburban Railway Co., of Toronto, propose extending their line from Lambton Mills into Peel county, the road ultimately to take in the villages along Dundas street to Oakville.

The Georgetown Electric Light Company, Ltd., Glen Williams; capital, $40,000; and the Glen Tay Power Co., Ltd., Ottawa; capital, $50,000, have been incorporated to construct and operate works for producing and distributing electricity for light, power and heat purposes.

H. T. Moore, for the past ten years with the General Electric Co., has been appointed superintendent of the Sherbrooke Street Railway Co., to succeed Raymond R. Smith. Mr. Smith was presented with a purse from the employees on severing his connection with the company.

The Montreal street railway has acquired the Montreal Park and Island railway, whose lines run from the north end to the Back river, Outremont, Cartierville and other suburban points, and also to Lachine. This will give the Montreal street railway complete control over the traffic in these districts.

Robt. Stuart, T. E. Wells, H. P. Crowell, Chicago; Z. A. Lash, Hon. G. A. Cox, Toronto; A. A. Cox, A. P. Poussette, W. G. Morrow, Peterborough, and W. Scott, Ottawa, have been incorporated as the Peterborough Hydraulic Power Co., Ltd.; capital, $250,000; head office, Peterborough.

J. H. Jewell, of John H. Jewell & Co., has organized the "Port Dover Building Improvement Co.," which proposes to build an electric railway from Port Dover to Brantford, and erect 100 summer cottages, and a $15,000 hotel on the lake shore. The scheme also contemplates waterworks, sewage and electric lights.

J. Caldwell, J. McEwen, W. D. Ferris, F. Campbell J. Sutherby, Jas. Brookbank and E. P. Rowe, have been incorporated as the Grey and Bruce Oil & Gas Co., Ltd., to prospect and sell petroleum oil, and to construct and operate works for producing natural gas for light, heat and power purposes; capital, $100,000; head office, Hepworth, Ont.

The electric plant being installed on the steamer "Advance" for the J. & J. Matthews Co. by the Jones & Moore Electric Co., is a remarkably compact outfit. The 150-light dynamo and engine, mounted on the one bed taking up a space of only about 3-ft. high, 2½-ft. wide and 4-ft. long. It has been subjected to a severe test, and proven to be all that can be desired for steamboat lighting.

Before a meeting of the Engineers' Club, of Toronto, last month, Roderick J. Parke, gave a lecture on the application of electricity to manufacturing purposes. Mr. Parke compared the relative cost and efficiency of steam and electricity in equipping factories with power, and his conclusion was that the latter was more economical where power has to be distributed to many departments and used in varying units.

John Knox, A. T. Duncan, Hamilton; P. J. Crowley, C. J. Baby, D. M. Walker and M. J. McCarron, St. Catharines, have been incorporated as the Lincoln Electric Light and Power Co., Ltd., to construct, maintain and operate works for the production, sale and distribution of electricity for light, heat and power; capital, $400,000; head office, St. Catharines, Ont. Mr. Knox denies that this company has any connection whatever with the Cataract Power Co., as stated last month.

The Metropolitan Power Co. at Brittannia, near Ottawa, have had a large force of men at work all winter, and the gigantic power canal is well on towards completion. Before this canal can be cut through to the river, however, an immense coffer dam will have to be constructed to hold the river water back while the work on the rock cutting is pushed ahead: work on the big power house will be commenced at once. It is expected that water will be let into the canal in September next; at present the rock is being removed at the rate of about 250 car-loads a day. Timber is being placed in position for the construction of the permanent coffer dam, and concrete will be manufactured for the piers and power houses.

The Toronto Suburban Electric Ry. are petitioning the Ontario Legislature for permission to extend their lines to Hamilton.

The Toronto Street Ry. are building 60 large new street cars at a cost of $30,000 in anticipation of a big rush during the Pan-American Exhibition.

The Guelph Ry. Co., through Secretary E. A. Sleeman, ask to amend their application, now before Parliament, for power to build to the town of Hespeler. They want to extend to Berlin.

The Rimouski Electric Co. has become incorporated with a capital of $100,000; headquarters at Fraserville, Que. Thomas Lebel, of Fraserville; J. N. Poulinot, of St. Germain de Rimouski, and others are charter members.

Superintendent Phillips, of the Winnipeg Street Railway, has reported to his company the necessity of double tracks on their lines in the near future. Ten more new cars will be added in May. The passengers carried last year were over 3,000,000.

The Railway Committee of the Ontario Legislature have passed the bill incorporating the Windsor, Essex and Lake Shore road to run from Windsor to Wheatley village. The promoters asked leave to use steam or electricity, but the clause was so amended as to make electricity the sole motive power.

The Windsor & Chatham Radial Ry. having secured right of way through several townships in Essex county will abandon the Talbot road route at Leamington, and run on the middle road to Chatham, as the latter way will reach more inhabitants; the road is 80 miles long, and will cost $800,000 to build and equip it.

The Toronto Street Ry. Co. are negotiating for the purchase of land to lay out a park near the banks of the Humber river, to be called Humberside Park, and reached by the Toronto line and their leased suburban extension, the Mimico Electric Ry.; it will be run on the same plan as their other pleasure resort Munro Park, on the other side of the city.

The Grand Trunk are about to put on electric cars of their own, over the Victoria bridge, which will connect with all other systems of street or electric cars on both sides of the river St. Lawrence. They prefer to do this rather than give running powers to so many different electric railways, as they can thus control the traffic, and prevent its interfering with their enormous steam traffic.

Cobourg town council have given pole rights on the streets to the Central Ontario Power Co., of Peterboro, for transmitting electrical energy for street railway and light and power purposes, from Burleigh Falls. The Port Hope council passed a bylaw for the same purpose last month, as also all the intervening towns have done between Port Hope and Burleigh Falls. Some of the prominent stockholders are Hon. R. Harcourt and E. Coste, J. Kendry, M.P., J. Dick, W. H. Riddell, K.C., of the Crossan Co.; H. A. Ward, M.P., and J. A. Culverwell. The transmission line would be 27 miles to Port Hope and 34 to Cobourg.

Railway Matters.

The Quebec and Lake St. John Ry. have decided to build a short line from Valcartier to St. Catherines, a distance of four miles. The contract has been awarded to Jos. Paquet. An iron or steel bridge 500 feet long and 50 feet high, will have to be built.

It is said an extension of the Brockville and Westport railway is contemplated, so as to connect with the Kingston and Pembroke, which may amalgamate with the Gatineau Valley Ry. This would also give a connection via the K. & P. with the Canadian Pacific.

R. McCallum, government engineer, reports that 140 miles of the Central Ontario Railway, from Picton to Bancroft, are now completed, and that it will be carried on this spring and summer by an additional 40 miles to Whitney on the Canada Atlantic.

Mr. Ross, of Rimouski, M.P. for Matane, is seeking government aid to build a line from St. Octave de Metis to Matane, a distance of 30 miles, or for the government to build a branch of the Intercolonial between these two points.

Traffic between Fort Erie and Black Rock over the Niagara River was suspended last month for 12 hours to enable the Grand Trunk to put in the centre or swing span of the newly rebuilt international bridge across the river.

The Canada Atlantic has surveyed three routes for a new short line from Ottawa to Montreal. By one of these—Glen Robertson to Vaudreuil—the time between Ottawa and Montreal may be cut down to 1½ hours. The short cut may be started at once.

The Railway Committee of the Privy Council have passed the bill extending the time for the completion of the South Ontario Pacific Ry. The road is to run from Woodstock, Ont., to the Niagara River, and will be a continuation of the Canadian Pacific line from Detroit to Woodstock.

The Crow's Nest Southern Railways petition for a charter, signed by half a dozen rich Toronto capitalists, Senator Cox, E. Rogers, H. M. Pellatt, J. W. Flavelle and others, is before the Dominion House. The line is to run from the Crow's Nest coal mines southward to the boundary, where it is to be met by a branch to be built north from the Great Northern Ry.

The Grand Trunk is putting a number of big mogul locomotives which they are turning out at the Point St. Charles shops, on the run between Montreal and Island Pond; they have double the hauling capacity of the old type of engine, and are particularly of use on long runs, of say 150 miles with large fast freights hauling grain, etc.

A company consisting of Col. McNaught J. Chamberlain, general manager of the C.A.R.; J. G. Scott, of the Lake St. John Ry., and others, received a charter in 1895 to build a line from Quebec to Fort Simpson on the Pacific Coast. They are said to be about to commence active operations under promise of aid from the Quebec and Ontario governments. They are now asking for $6,400 bonus from the Dominion Government.

Robt. Wood and J. Kerr, of Greenwood, B.C., and others are applying to the provincial legislature for a charter to build a railway from either Midway or Rock Creek to Vernon in the Okanagan district. The route of the proposed line is up the west fork of Kettle River, and thence on to Vernon. C. A. E Shaw, C.E., is now out making a preliminary survey of the country between West Fork and the Mission. This line will give Okanagan people easy access to the Boundary mining country.

President Shaughnessy, of the C.P.R., states that the company will go ahead with the proposed big hotel at Winnipeg. The building will be practically the same as was first designed, and will cost $500,000. The company is putting up a building at Toronto Junction in which it proposes to install an electric light plant for their shops, yards and station. At present the station is illuminated by light from the city system. Lumsden, one of the company's engineers, has finished surveying a line from Woodstock to Brantford, Ont., which will be built in time for the Pan-American Exhibition at Buffalo.

The supplementary estimates passed by the Ontario Legislature contain railway grants as follows: To the Bracebridge and Trading Lake railway, 16 miles, cash subsidy of $3,000 a mile; to the Bruce Mines and Algoma railway, from Bruce Mines to Rock Lake copper mines, 13 miles, $3,000 a mile; to a railway from Bolton Creek to the iron mines in the township of Lanark, 25 miles, $3,000 a mile, to the Norwood & Apsley railway from Norwood on the C.P.R. to Apsley, 25 miles, $3,000 a mile, and to the Port Arthur and St. Joe railway, from Pt. Arthur northeast towards Lake Nepigon, 30 miles, $2,000 a mile and a land grant of 5,000 acres per mile.

The following lines have been contracted for in connection with the Clergue interests: Two hundred miles of new line from Sault Ste. Marie north of Amyot on the Canadian Pacific Railway, with a branch from the last named point forty miles southwest to Michipocoten Harbor, on Lake Superior; James Conmee and Fauquier Bros., of Sault Ste. Marie, are the contractors, while Foley Brothers, of St. Paul, Minn., have the contract for 100 miles north of Sault Ste. Marie. Thirty miles of the main line to Goulars river and twelve miles on the branch from Michipicoten Harbor to Helene mine have been completed. Work on the line from Missanabie, north about 250 miles to Moose Factory, on Hudson Bay, is to begin as soon as the road is completed to the first named point. It is expected Hudson Bay will be reached in two years.

Marine News.

It is expected that the Welland canal will be opened for navigation on April 22.

The Dominion Government have decided to invite tenders for the construction of two steel steamers to replace the "Druid," condemned as obsolete, and the "Newfield," wrecked last year; the "Druid," which is now being dismantled in dock at Quebec will be sold by auction.

The Niagara, St. Catharines and Toronto Ry. Co., in addition to having purchased the steamer "Garden City," and "Lakeside" to make their water connection between Port Dalhousie and Toronto have also acquired the dock privileges of the Lakeside Navigation Co. at Toronto, St. Catharines and other points, and are contemplating taking over the Lakeside Navigation Company's other steamer "Lincoln," and putting her on the route between Port Dalhousie, Hamilton and Toronto, so as to make another feeder to the road which will shortly be electrified throughout its entire length to Niagara Falls. Captain Wigle, the founder of the Lakeside Navigation Co. will have a prominent position with the company. G. M. Neelon, the general passenger agent, states that passenger traffic is already established between Port Dalhousie and Niagara Falls, N.Y., via, the new Niagara bridge, and will be run by electricity direct to the Pan-American Exhibition grounds.

The steamers of the Northern Navigation Company (Collingwood line), and the Northwest Transportation Co. (Beatty line), will this season all ply between Sarnia, Windsor, Port Arthur, Fort William and Duluth, it having been decided with a view to meeting the demands of the Winnipeg and western trade, to withdraw the Collingwood service. The whole business will be carried on at Sarnia, the "City of Collingwood" going to that port to sail in consort with the "United Empire" and "Monarch." The "Majestic" will be placed on the Sault route along with the steamers "City of Midland," "Germanic" and "Britannic." The "Atlantic" will again be on the North Shore route and the "City of Toronto" on her old run between Penetang and Parry Sound. The following are officers of the various steamers: W. Harmon will be chief engineer. "Majestic"—P. M. Campbell, master; J. W. Aston, engineer. "City of Collingwood"—J. W. Bassett, master; C Robertson, engineer. "City of Midland"—E. Walton, master; W. Whipps, engineer. "Germanic"—R. D. Foote, master; J. Aston, engineer. "Atlantic"—J. Wilson, master; F. Cleland, engineer. "City of Toronto"—J. O'Donnel, master; W. Harmon, engineer. Capt. La France, who sailed the "City of Midland" last season, has been engaged to sail the new steamer "Kingston," running between Montreal and Toronto.

Personal.

Capt. Robt. Nelson, for more than 35 years in the employ of the R. & O. Nav. Co., died suddenly of heart disease at his home, Ste. Victoire, Que., on February 14th, aged 70.

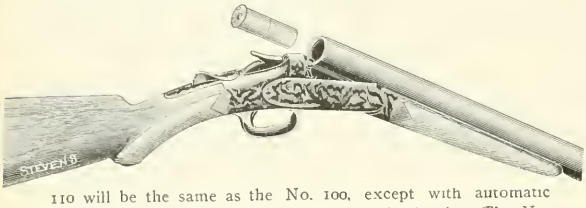
Harry E. Beaseley, chief clerk in President Shaughnessy's office (C.P.R.), has been appointed superintendent of the Pacific division of the Canadian Pacific, vice W. Downie promoted to the superintendency of the Kootenay division with headquarters at Nelson, B.C

Henry C. Symmes, the senior partner of the well-known firm of railway contractors, died at his home Niagara Falls, Ont., on March 9. Among their many large railway contracts

was the Pacific Junction Ry. from Gravenhurst to North Bay, Ont. He was one of the chief promoters of the Ontario Power Co. to construct an hydraulic canal from Chippewa to Queen Victoria Park, Niagara Falls, Ont., for electric power purposes; he was 60 years old, and leaves a wife, two sons and a daughter.

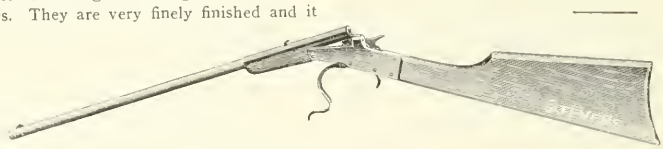
NEW STEVENS GUNS AND RIFLES.

The accompanying cuts illustrate the No. 100 and No. 120 single barrel shotgun, together with the new Stevens-Maynard, jr., rifle, which the J. Stevens Arms and Tool Co., of Chicopee Falls, Mass., expect to put on the market about the 15th of this month. These are entirely new goods. The single barrel shotgun is built in three numbers. The non-ejector will have "electro steel" barrel, choke bored, pistol grip, rubber butt plate, case hardened frame, bored for nitro powder. The No.

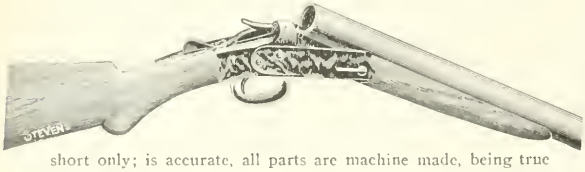


110 will be the same as the No. 100, except with automatic shell ejector. It has a checked, capped pistol grip. The No. 120, which is called the "fancy ejector," will have a patent fore end, an automatic ejector, which is a special device whereby the operator can change it at will from an ejector to an extractor by two turns of a screw. The No. 100 is listed at $7.50; the No. 110 at $8.50, and the No. 120 at $10.

They are made in the usual weight and length of barrel, and in 12, 16 and 20 gauges. They are very finely finished and it



is claimed they are the handsomest guns that will be put on the market this year. The Stevens-Maynard, jr., has the same action as the old Maynard rifle, from which this was designed, and special attention has been paid to the quality, finish and accuracy of the rfle. It has an 18-inch half-octagon barrel, steel frame, walnut stock and steel butt plate. It shoots 22



short only; is accurate, all parts are machine made, being true to gauge and interchangeable. It weighs 2 lbs. 14 oz., and comes packed one in a box, and lists at $3 with the usual discount to the trade. This with the Stevens new crack shot rifle (which lists at $1), will eventually supplant the cheap imported Belgian Floberts. The goods noted above will be marked in the usual way through the jobber.

Mining Matters.

I. A. Morrison, J. Curry, Toronto; P. S. Merrill, Buffalo; G. A. Sanborn, Kenmore, A. J. Hathaway, Tonawanda, have been incorporated as the Imperial Corundum Company, to operate a mining, milling, reduction and development company; capital, $1,000,000; head office, Toronto.

Manager Kerby's report on the War Eagle gave as an estimate of the ore reserve, 35,000 tons, averaging about $1.1 per ton, which, on the basis of last year's cost of mining and smelting, would yield but $116,000. This is the amount in sight to meet indebtedness of $583,599, which amount must be made up from the product of the mine before there will be prospect of a legitimate dividend. The total output of the War Eagle mine, according to the report to the shareholders, so far has been but 139,052 tons. The annual statement shows that before reaching a dividend-paying basis more than five times the estimated ore reserve must be disclosed, mined and smelted—an amount, 36,730 tons more than the total tonnage ore production of the mine during its seven years of operation.

R. S. LOGAN, VICE-PRESIDENT AND GENERAL MANAGER, C.V.R.

Mr. Logan, who was recently promoted to the position of assistant to the general manager of the Grand Trunk, has been elected Vice-President and General Manager of the Central Vermont Railway. A biographical sketch of Mr. Logan appeared in our February number.

—Experience has clearly demonstrated that in this climate no system of ventilation can be successfully operated by itself and independently of the method of heating that may be adopted. It is, in fact, a vital element of success that the two systems be most intimately combined, for they are clearly interdependent, and when properly applied are so interwoven in their operation and results, that disunion is certain to bring about failure. For the purpose of ventilation, the fan was first applied upon a practical scale about the middle of this century, but only to a limited extent, and it was not until the fan and the steam heater in marketable form were introduced by B. F. Sturtevant, of Boston, Mass., that the so-called "blower system" became a reality. The system, of which these two elements are the most important factors, as originally by this house, has naturally been known as "The Sturtevant System." This system, is at once practical, successful and economical; for, air being the natural conveyor of heat, it may, when properly warmed and supplied, perform the double office of heating and ventilating. As applied, the Sturtevant system forced the air into the apartment by the pressure of plenum method.

PATENT NOTICE

Thomas Albert Darby and Sidney Charles Darby, both of Pleshey, Essex, Eng and, the owners of Canadian Patent No. 55,133 for improvements in Cultivators, are willing to grant licenses for the use of said invention or otherwise to supply same. The owners are also willing to sell the Patent outright. Applications should be made to OWEN N. EVANS, Solicitor of Patents and Expert, Temple Building, Montreal. 4-1

A COMPETENT BOOK-KEEPER wishes situation as accountant, or for general electrical work. Address, **R.H.**, c/o Canadian Engineer.

WANTED—A Mechanical Draughtsman. One accustomed to general machine design preferred. Address D. B., care of Canadian Engineer, Montreal, P. Q.

Position Wanted by Electrician; competent wireman and lineman, experienced in both steam and water power, electric light and power plants; can give best of references or will go on trial. Address G. H. C., care of The Canadian Engineer, Toronto.

The Canadian Engineer

VOL. VIII.—No. 13. TORONTO AND MONTREAL, MAY, 1901. {PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main **1392.** **Montreal Telephone,** Main **2589.**

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Amber Asbestos Air Cell Covering	285
American Steam Guage & Valve Mfg., Co	292
Answers to Correspondents	292
Beet Sugar Industry	292
Boring Tool Holders	283
Buffalo Railway Co.'s Power Plant	283
Catalogues Received	298
Cement, Portland	285
Civil Engineering, Construction Methods in	288
Draw-Bridge Gate, Interlocking	299
Electric Flashes	
" Power to Toronto	291
" Railways of Canada	287
Engineering Ethics	283
Ice Breaking Steamers in the St. Lawrence	299
Industrial Notes	293
Literary Notes	297
Lubricating a High Speed Engine	283
Marine News	297
Metal Trade of Great Britain with Canada	292
Metric System	282
Milleroche's, Water Power Development at	279
Mining Matters	296
Personal	295
Portland Cement	285
Railway Matters	295
Shawinigan Water and Power Co.'s Plant	273
Telephone. The Modern	284
Water Power Developments at Milleroche's	279

CONSTRUCTION OF THE SHAWINIGAN WATER AND POWER CO.'S PLANT.

(Concluded from last issue).

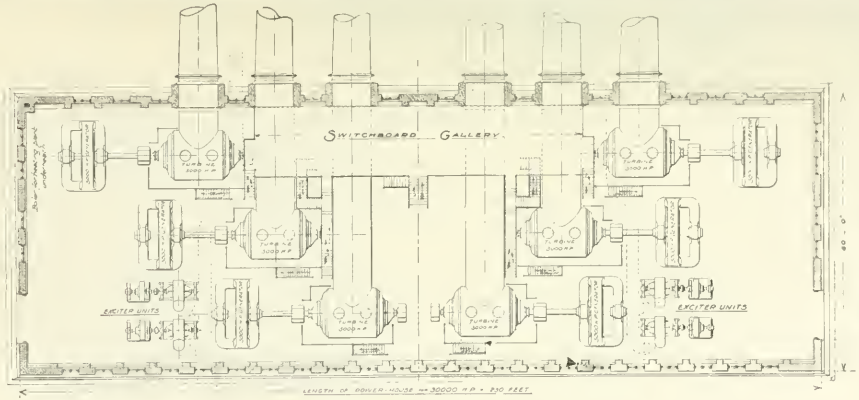
It was originally expected that the bulkhead at the lower end of the head race would be built simultaneously with the excavation in the head race, but for various reasons it was delayed until the frost made the laying of concrete inadvisable, and provision had to be made for its construction last spring. The coffer-dam at the intake was exposed to the full force of the open river, and not calculated to stand against floods, nor was it high enough to exclude high water. Further, it reduced the flood overflow area of the river by one-half, and any attempt to raise it would have increased the flood level of the river to a dangerous height. Therefore, a second cribwork dam was constructed across the head race, and it protected the bulkhead site after the outside coffer-dam was removed.

This coffer-dam is a single continuous crib built across on the level bottom of the head-race, and extended on the top of the bank on both sides to the high ground on the one side, and the cribwork permanent wing dam on the other side. The dam is 27-ft. wide for a height of 23-ft., and 16-ft. wide for its remaining height of 17-ft. It is of the same description of cribwork as described for the coffer-dam at the intake, and is sheathed in the same manner. Cross ties are framed 10-ft. apart in each course, and staggered in alternate courses, forming 5 x 11-foot ballast pockets. These are filled with loose stone closely packed, and loose stone has also been piled on top of the offset between the widths of 27-ft. and 16-ft. making the dam practically 27-ft. wide from top to bottom. The joint between the crib and the rock sides and bottom is made with concrete and puddled clay, the clay in vertical corners being held in place by corner-boards. Two flumes about 2-ft. sq. were carried through the crib to admit water when required. After the flood waters had subsided, the water in outer portion was allowed to drain off, being carried through penstock openings in bulkhead; when the bulkhead was altogether completed, the secondary coffer-dam was removed by two derricks, one on each side of the head race.

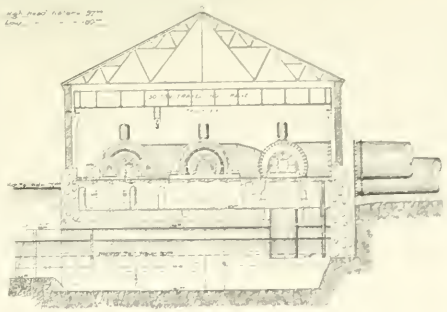
Another coffer-dam has been built in the tail-race to hold back high waters while the power-house foundations were being built. This dam is 26-ft. high, with cut-offs through the gravel to rock at each side, and is 200-ft. long; 160-ft. of its length, where it rests on a clay bottom, is built with an inclined top in bents of heavy rough timber on 4-foot centres. This dam is 80-ft. wide on the bottom. The covering is 2-in. and 3-in. dressed plank covered with two layers of tarred felt, protected by 1-in. boards, the felt and the joints in the boards being swabbed with hot pitch. The toe of this dam is made tight with doubled sheet piling well puddled. The remaining 40-ft. of the dam is formed of square cribwork, as previously described, 20-ft. wide. This will be removed after all turbines are in position.

The principal quantities in the main contract included about 175,000 cubic yards of excavation, 12,000 yards of cribwork in the permanent wingdam, etc., 5,500 yards of concrete in the bulkhead, and about 5,000 yards of concrete in the company's power-house, besides masonry for piers under pipe lines. The rock is very hard and seamy, and was drilled with a cross bit. About 700 pounds of dynamite were required for loosening each 1,000 yards of rock.

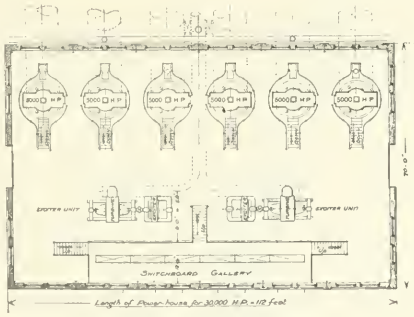
Water from the river was pumped by a Northey pump with 3-in. suction, and delivered to two storage tanks, one of which had a capacity of 2,000 gallons, and was elevated 75-ft. Service pipes from it supply boilers on both sides of the head-race. There were fifteen derrick engines of the Beatty and Lidgerwood types, six of which had power swinging devices. The swinging device was manufactured by M. Beaty & Sons, Welland, Ont., and consisted of a detached bed plate with two drums on one shaft driven by a double friction gear in the centre. The shaft is continuously driven by a pinion meshing into the gear of the forward drum of the engine. The swinging rope was wound on the horizontal wheel at the foot of the mast, and one end of it was wound on each drum. Either drum can be operated by a lever placed close to the engine, and when the rope was wound up on one drum it overhauled from



Plan of horizontal arrangement designed by
W. C. JOHNSON Esq C.E.
Niagara Falls, N.Y.
(Adopted by the Shawinigan Water and Power Co'y and now partly installed)



CROSS-SECTION
Horizontal arrangement



Plan of Vertical arrangement designed by
T. PRINGLE & SON, ENGINEERS.
Montreal, P.Q.

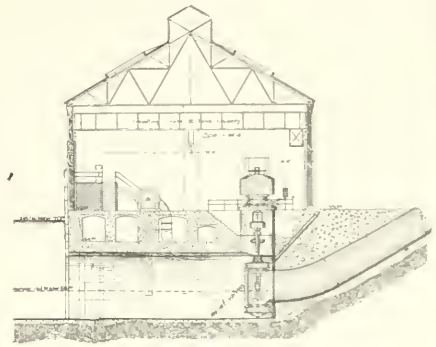
Comparison of Vertical and Horizontal arrangements
FOR 30,000 HORSE-POWER

Area occupied by Power-Houses.

Horizontal,	18,409 Square feet
Vertical	7,840 "

Increased cost of horizontal over vertical arrangement

On excavation, at one dollar per cubic yard	$ 9,740
" concrete and floors, at 6 dollars per cubic yard	40,200
" penstocks, at 55 dollars per running foot	10,000
" Building, brick, roof, windows and heating plant	5,420
	$ 65,360



CROSS-SECTION
Vertical arrangement

WATER POWER DEVELOPMENT
AT
SHAWINIGAN FALLS
ON THE
ST. MAURICE RIVER
PROVINCE OF QUEBEC ✻ CANADA.

Montreal, 1st February 1901

the other drum. There were about 80 Ryan & McDonald dump cars and three locomotives. There were 20 Rand and Ingersoll rock drills, and there were boilers aggregating about 350 horse-power, exclusive of the individual ones for the hoisting machines, portable boilers for the centrifugal pumps, and another to supplement the drill service. There was a 15-arc light dynamo from the Royal Electric Company, Montreal, driven by a 35 horse-power Laurie automatic engine, and lamps were placed on each side of the cut for night work. Weather-proof cement sheds of a total capacity of 10,000 barrels have been erected and filled with cement. There was a camp for boarding 300 men. The maximum number of men employed has been about 1,200. In the summer it was difficult to keep the men on the work, but they were anxious to work through the severe winter weather, and the rock excavation and crib building was carried on almost uninterruptedly with a force of over 1,000 men.

T. Pringle & Son, Montreal, were engineers for all preliminary surveys, the laying out of town site, mill sites and designs of all work with the exception of the power-house, as now being installed. They supervised all construction with exception of power-house building above the foundations. Wallace C. Johnson, of Niagara Falls, was consulting engineer during the period of construction, and is now in the direct employ of the Shawinigan Water & Power Co. Wm. I. Bishop, of Montreal, was engineer in charge of the entire work for T. Pringle & Son, and also had charge of erection of the Pittsburgh Reduction Co.'s plant. D. A Rexford, of New York, was the superintendent for the Warren-Burnham Co.

POWER-HOUSE ARRANGEMENT.

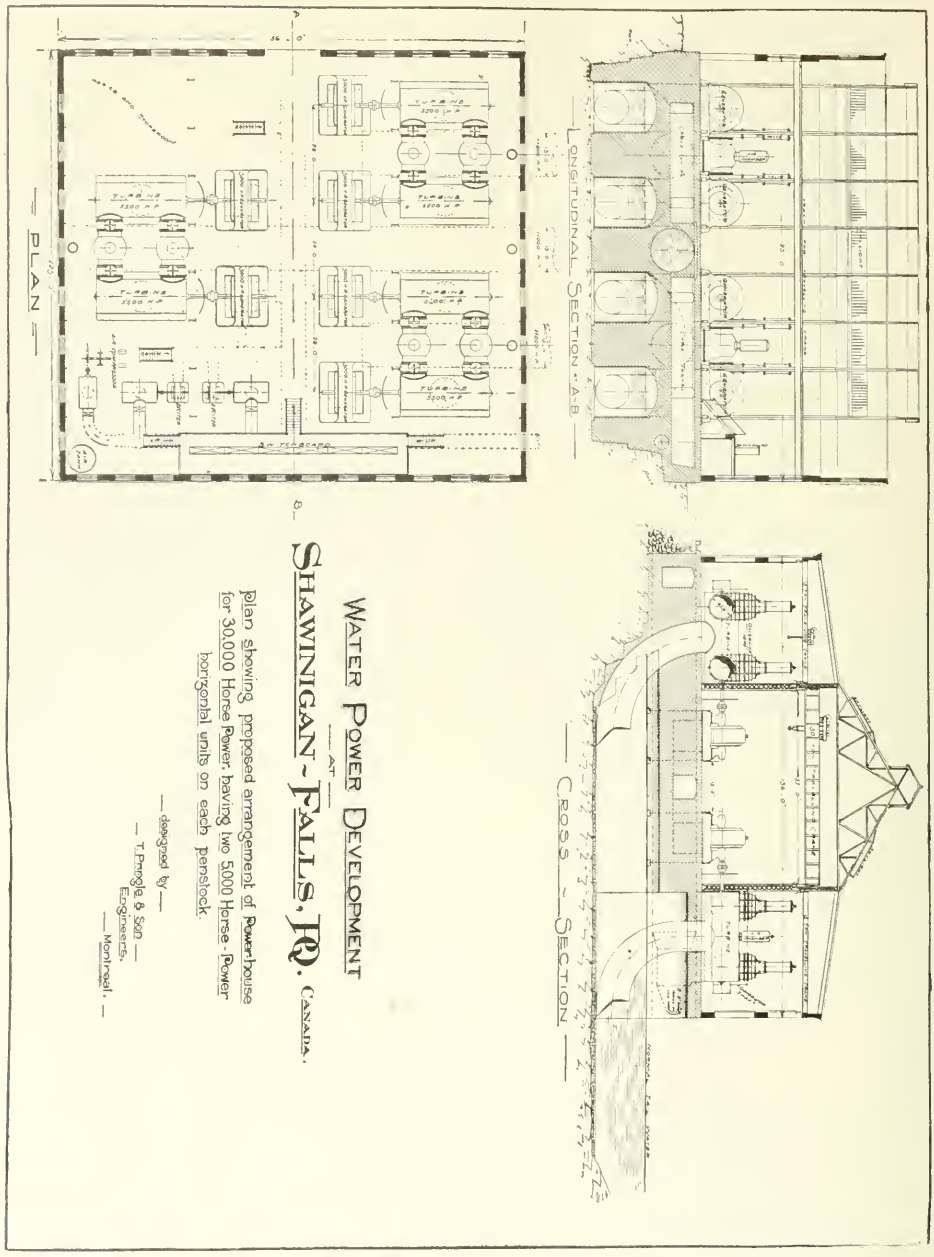
The nature of the location at Shawinigan Falls, and the size of the electrical units demanded were such that the power-house arrangement would be different from any plant then existing, and the possible forms of design were almost endless. As usual with an enterprise of this kind, and in accordance with the ideas of the promoters, the preliminary designs were made for a development far larger than it was afterwards found advisable to install. The power of these falls had been rated at from 300,000 to 500,000 h.p., under a head of 130 feet. The power afterwards actually found at low water (which must be figured on in the same way, as the strength of a chain is limited by its weakest link), is 80,000 h.p., under the same head. Figuring in the beginning, therefore, on having at least 150,000 h.p. to deal with, the head race and entrance were designed for ultimate extension to develop 100,000 h.p., leaving 50,000 h.p. for paper mill development at another point.

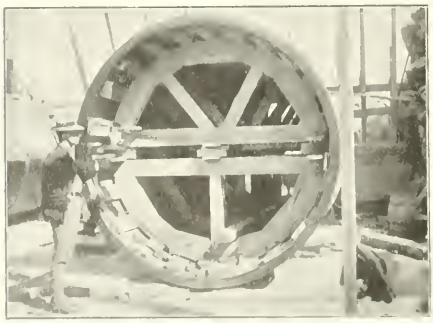
The bulkhead was first designed for five penstocks, each 13 feet in diameter, which were each to carry down to power-house enough water to develop 10,000 h.p. This bulkhead could be extended so as to provide 10 penstocks which would develop 100,000 h.p.

The first arrangement designed for power-house, was one in which one horizontal turbine unit of 5,000 h.p. was taken off each side of the 13-feet penstock. Valves were set on the connection between the turbines and wheel cases so that each 5,000 h.p. unit could be shut off without affecting the operation of the other. This arrangement, which was remarkably compact and convenient for a horizontal layout, is shown on accompanying sketch. One of its desirable features, was the ease with which air cylinders and safety relief valves, to obviate danger from water hammer, could be set on the end of penstock. This arrangement, however, while suitable for a total installation of 50,000 h.p., was not equally so when two or three units only were intended to be installed at first, as was decided on some time after this design was made, one reason being that the first two units installed would depend on one penstock only. Thus if it was found necessary to close this penstock, the whole plant would be shut down.

When the engineers were advised that only two 5,000 h.p. units would be installed at first, they immediately began to make studies for designs more suitable to the new conditions. The result was a design for a development using separate penstocks for each 5,000 h.p., and having the shafts of the turbines and generators set vertical, resembling, in this, the famous development of the Cataract Power Co., at Niagara Falls, of which the last ten units, making up 100,000 h.p., are now being installed. The power-house, laid out according to this plan, was exceedingly cheap, compact and convenient, the dimensions for 30,000 h.p. being only 75 feet wide by 110 feet in length; these dimensions, giving a clear passage of 15 feet through the building, and allowing ample room for switchboards, exciters, etc., as well as providing space for heating plant, transformers, and other necessary adjustments, to a complete self-contained power-house. A particularly desirable feature of this design, under the existing conditions, was that the foundations could be built and power units installed one by one, as desired, on much the same principle as "elastic bookcases," now used so extensively.

On going into the details of turbine and generator arrangement, it was found that a particularly efficient and desirable arrangement could be installed on the vertical shaft system. After very careful enquiry it was found that the only fault with the vertical arrangement as installed at Niagara, was that caused by the burning out of the thrust bearing on the shaft when the water levels varied considerably above or below those for which the turbines were designed, which had happened only once or twice since the plant was built. Under normal conditions, the water flowing out of turbines is made to carry the whole weight of the immense shaft and generator above, which thus revolves on a water-bearing with a minimum of friction. The thrust bearing was designed to take care of only five or six feet variation in the head, and ice blocking the entrance to head race caused the water to fall much below this, thus throwing more load on the bearings than they were designed for. The arrangement of turbines, proposed for Shawinigan, however, was designed to overcome this difficulty. To begin with, the vertical shaft was only one-fifth as long as that at Niagara. On this was to be placed an hydraulic step-bearing, which was to come into play whenever the water varied above or below the normal level. The small amount of friction on a bearing of this kind will be readily understood. In addition to this, however, a heavy thrust bearing, large enough to carry the weight of all revolving parts was to be placed on the shaft and held in reserve. A


— PLAN —
— LONGITUDINAL SECTION A-B —
— CROSS-SECTION —
WATER POWER DEVELOPMENT
— AT —
SHAWINIGAN-FALLS, P.Q. CANADA.
Plan showing proposed arrangement of Powerhouse for 30,000 Horse Power, having two 5000 Horse-Power horizontal units on each penstock.
— designed by —
— T. Pringle & Son —
Engineers,
— Montreal. —



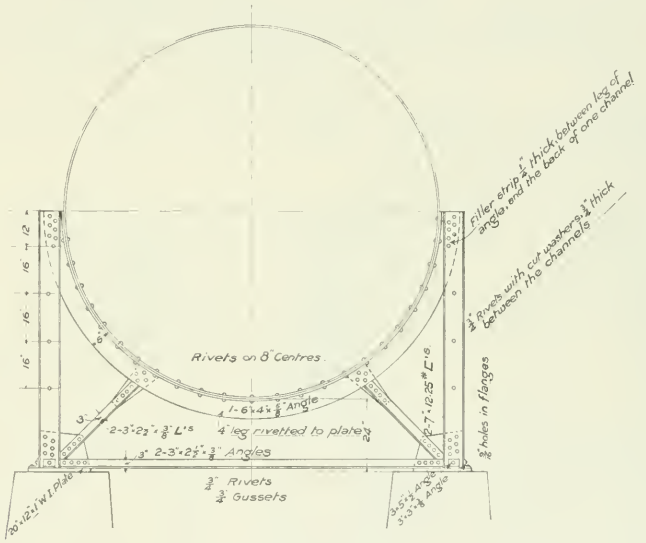
One of the Steel Inlet Cones showing bracing used to keep them in shape while being built into concrete.

Concrete Foundations in Power House.

bearing of this kind, compared with those on ocean steamers, which take the whole thrust due to driving immense vessels, at high speed, would be very small, indeed. This arrangement also permitted the placing of numerous relief valves on the wheel case to take care of the immense shock due to water hammer or ram caused by sudden closing or opening of the turbine gates. These safety valves discharge directly into the tail races. Steel stop-logs or gates were to be provided for the end of tail race, which could be placed in position should any repairs be required on turbines, and a centrifugal pump operated by a small motor would then empty the wheel pit in ten to fifteen minutes

The consulting engineer of the company, W. C. Johnson, who was at that time connected with the Niagara Falls Power & Manufacturing Co.'s power installation, known as the Shelcroft plant, at Niagara Falls, submitted various plans for a horizontal arrangement of turbines. After considering these plans and comparing them with the plans for a vertical arrangement, the directors of the company decided to adopt the turbine and generator units staggered so that the generator on each unit is directly alongside of the wheel case of the other units. At the centre of the power-house the arrangement is reversed. The turbines are double turbines discharging into a central draft tube. A small air cylinder is set on the top of the case to assist the governors in taking care of the ram effect produced in 500 feet of 9 feet pipe, caused by sudden closing of the gates under changes of load on the generator.

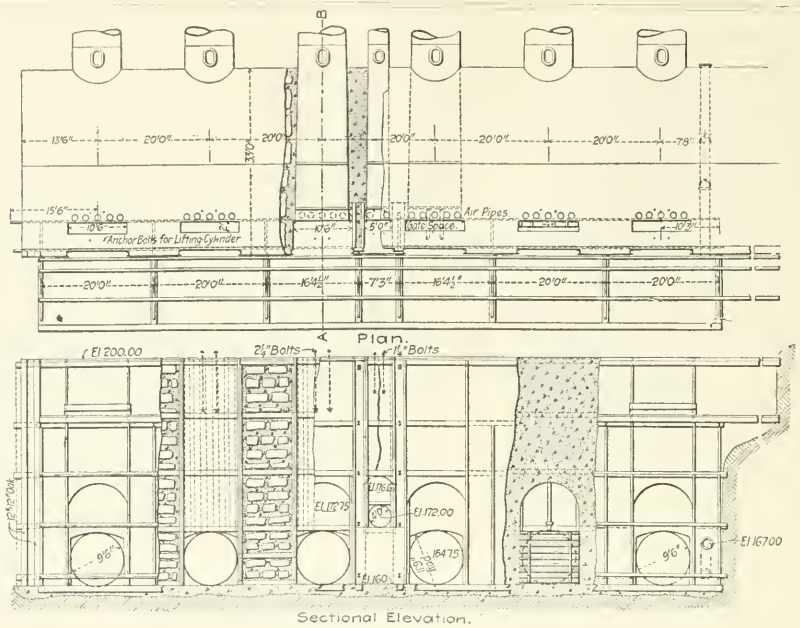
A separate penstock is provided for the exciter units, which consist of two 400 h.p. turbines direct connected to exciters. Valves are provided so that each unit can be shut off at will and either of the exciters can handle the entire plant. The two generators on order have each a capacity of 3,750 kilowatts, and are of the Westinghouse rotating field type, with twenty poles provided with heavy copper dampers to check interchange of idle currents, when working in synchronism, and are designed to operate at 180 p.p.m., giving two-phase currents at 30 cycles per second and 2,200 volts.


Filler strip ⅜" thick between leg of angle, and the back of one channel
¾" Rivets with cut washers ¾" thick between the channels
Rivets on 8" Centres
1-6"x4"x⅝" Angle
2-3"x2½"x⅜" L's 4" leg rivetted to plate
3" 2-3"x2½"x⅜" Angles
⅞" Rivets
⅝" Gussets
8" holes in flanges
2-7"x12.25#" L's
3-3½"x3½"x⅜" Angle

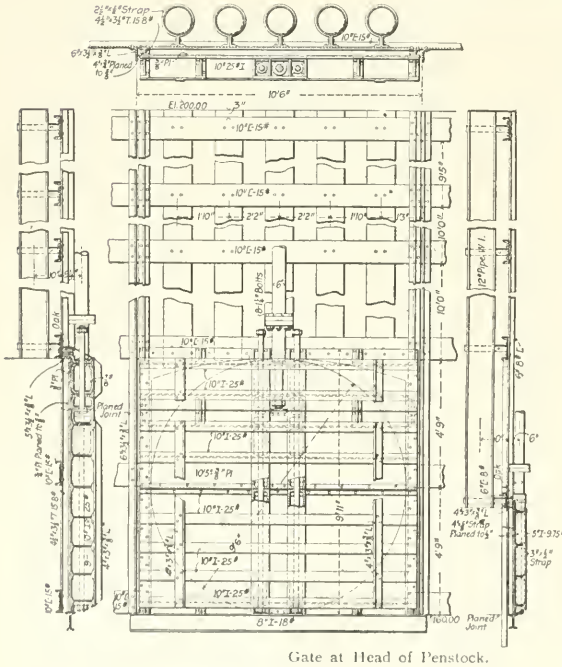
Steel Saddles for Penstocks.

the horizontal arrangement. On comparing the two plans together, it is rather difficult to see how this decision was arrived at. The size of the power-house for the horizontal arrangement, appears to be twice as great as that for the vertical arrangement, necessitating a proportionately larger amount of expenditure for foundations, and the nature of the lay-out does not permit of adding to the plant unit by unit as does the vertical arrangement. The vertical arrangement also appears much more compact and more easily supervised from the switch-board. In this arrangement, too, there is an entire absence of wheel cases or other hydraulic appurtenances on the power-house floor. The horizontal arrangement, as designed, and now being partially installed under the supervision of Mr. Johnson, consists, as will be seen on accompanying plan, of wheel cases at right angles to the penstocks, having direct connected generator units of 5,000 h.p. each. The three penstocks to form one-half of the power-house are carried one beyond the other across the power-house, and An extremely roomy switch-board gallery is set in the space left by staggering the power units, and it is elevated above the level of the top of penstocks. An electric crane, capable of handling 50 tons, affords means for setting machinery or removing parts of same for repairs. The power-house building is of brick built to a neat and substantial design. The whole arrangement, as now built, provides for 15,000 h.p., being one-half of the finished power-house, as now designed. The hydraulic pistons on top of the bulkhead will be housed in by a neat brick building, which will be kept heated to a moderate degree. A covered passage along the top of the exciter penstock will afford means of access from the power-house to this building. The contractors for the steel penstocks of these works were Carrier, Laine & Co., engineers, Levis, Que.

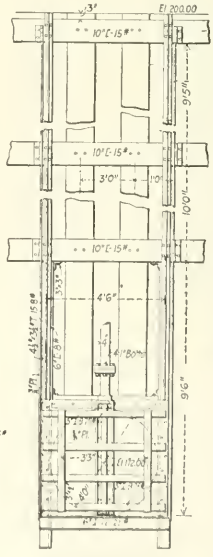
The company's head office is in Montreal. The officers of the company are: President, J. N. Greenshields, K.C.; vice-president, John Joyce; treasurer, J. E. Aldred; secretary, R. W. Douglas.

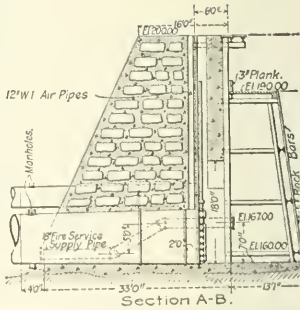


BULKHEAD AND PENSTOCKS.

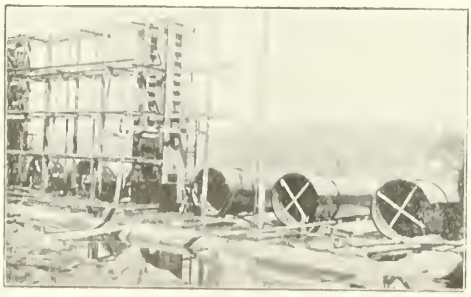


Gate at Head of Penstock.





Section through Penstock

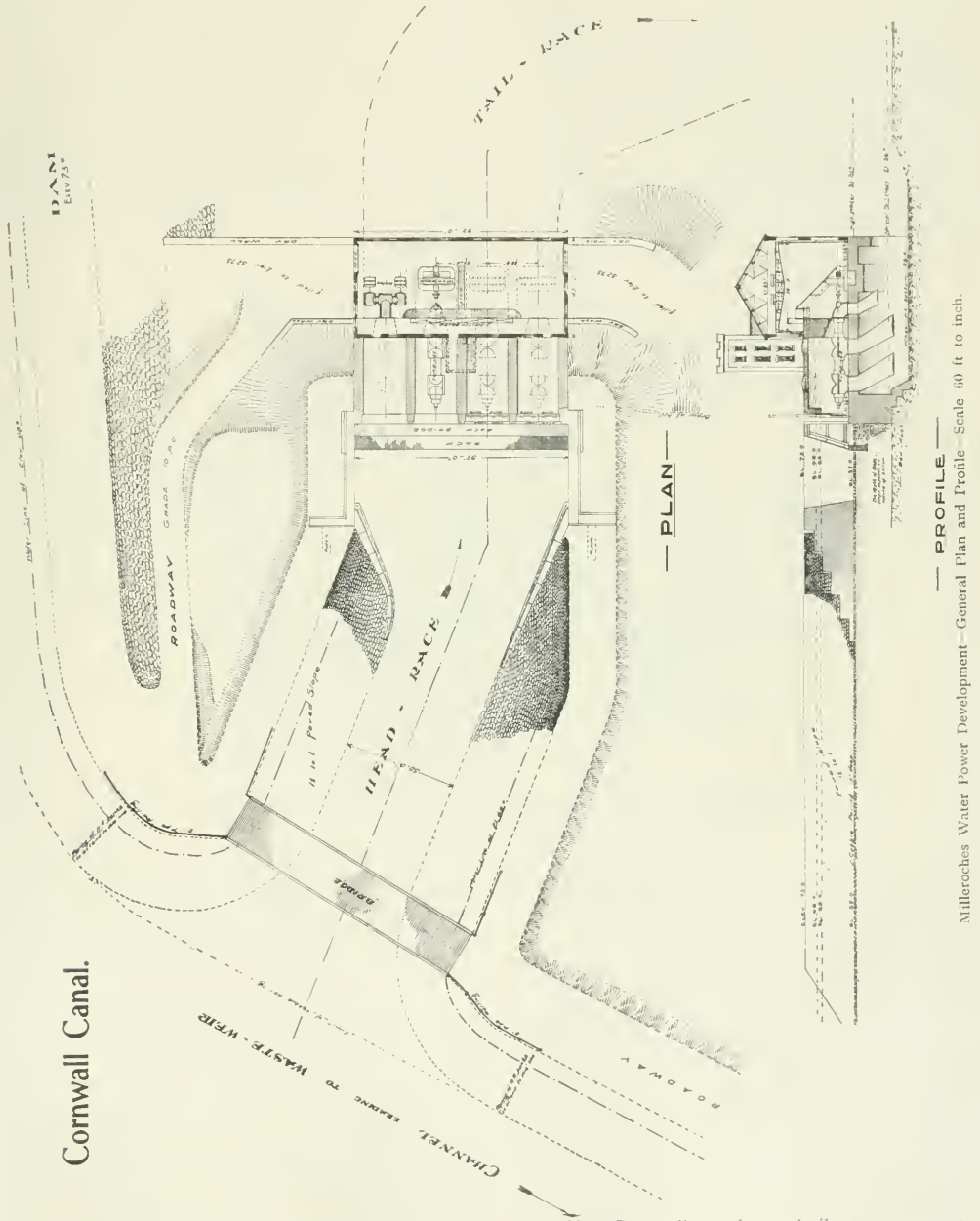


Erecting Inlet Cones and Steel Work in Bulkhead

Caissons for Power House Foundations

WATER-POWER DEVELOPMENT AT MILLEROCHES, NEAR CORNWALL, ONT.

A water-power development possessing some interesting features is now being installed at Milleroches, Ont. This power will take water from the Cornwall canal, one of the St. Lawrence system of waterways, through a very short head race, and will discharge directly into an old channel of the St. Lawrence river. The first development will provide for 4,000 h.p., under a head varying from 20 to 30 feet. 1,000 h.p. will be installed at once, and used for lighting the Cornwall canal, and operating its locks under contract with the Dominion Government. Power will also be transmitted to Cornwall, Ont., six miles distant. This is a manufacturing town of about 8,000 inhabitants, the principal industries being the manufacture of cotton goods, woolen goods and paper. It is on the main line of the Grand Trunk Railway and New York & Ottawa Railway, and the St. Lawrence canal system gives water transportation to Montreal, the head of ocean navigation.



Milleroches Water Power Development—General Plan and Profile—Scale 60 ft. to inch.

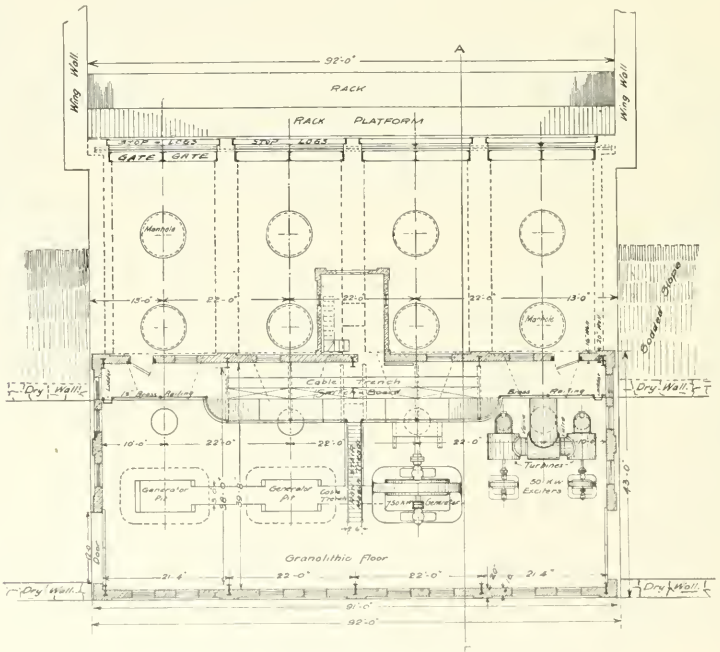
The Cornwall canal was built to surmount the Long Sault Rapids of the St. Lawrence river, the total lift in the canal being about 48 feet in a length of twelve miles. In building this canal, the shore of river was followed, and the canal thereby made extremely crooked. To get rid of one of the most

crooked sections of the canal, the Government, a few years ago, built two dams from the mainland to Sheik's Island. These dams are about three miles apart, and they have formed an artificial lake giving a splendid channel 30 feet deep, over ten times the width of the old canal. At the lower dam, which is situated about five and a half miles from the up-stream end of the canal, the difference between the water in the canal and the water in the river at low water is nearly 38 feet. It is at this point that the present water-power development is being installed. A regulating weir was built here by the Government for regulating the height of water in the canal, which is kept at a minimum depth of 14 feet. From the channel leading to this weir water will be taken in a head race about 200 feet long, and after passing through the turbines will discharge into the bed of the old river channel laid dry by the building of the dam.

tion, while the dredge is at work, this road will be carried across the top of the flume or wheel chambers. After the cut is completed, a substantial steel highway bridge of 120 feet span will be erected.

POWER-HOUSE.

At intervals of several years the river below the power-house rises 20 feet, reducing the head to 18 feet. Ordinary high water rises only 14 or 15 feet, leaving 23 to 24 feet head. High water occurs in the winter, and is caused by the blocking of the river channel below Cornwall by the immense quantities of anchor ice and frazil formed in the Long Sault rapids. Heavy snowstorms with intense cold cause the extra high water above referred to. The arrangement of turbines is designed to run up to speed and almost full capacity at the lowest head of 18 feet, the normal head being 30 feet.



Milleroches Water Developments, Plan of Power House—Scale 24 ft. to an inch.

DEVELOPMENT.

Head Race.—The formation of the ground consists of glacial drift about 40 feet deep overlying rock at the level of the old river bed. A head race will be cut in from the face formed by the old river bank. This head race will be 50 feet wide on the bottom with side slopes of at least 1½ to 1 inch, and will be excavated to a depth sufficient to give 14 feet of water at all times. A portion of the old bank 15 feet wide on top will be left between the head race and the canal, and when work on the power-house is sufficiently advanced, a dredge will start in from the canal and take out the balance of the excavation. The banks and bottom of the cut will be paved with boulders. Part of this paving will be carried out this summer, the balance, where cut is dredged, will be done when the water is out of the canal in the spring of 1902. A road now runs across the site of head race. During construc

Tail Race.—With the level adopted for normal tail water, practically no excavation will be required in tail race.

Wheel Pit.—The wheel pit will be excavated out and the bottom, which is of limestone, will be protected by a layer of concrete, and on this will be laid 2-in. plank laid on bevelled sills 6-in. by 12-in.

Walls.—The walls will be carried up to the level of the springing line of arches in heavy limestone masonry, dressed through on the horizontal beds and laid in Portland cement mortar. The heavy breast wall at the up-stream end of the power-house will be built of rubble concrete, composed of large rectangular blocks of limestone laid 12 inches apart, and filled between with 1-3-5 concrete, the stone in this concrete being broken to one inch and smaller. The whole of the foundations will be built on the solid rock.

Arches.—The wheel pit arches are semi-circular in shape, and will be built of 1-3-5 concrete, faced on

down-stream side with cut stone. A cut stone base course is carried all around building. The floor of the power-house will be laid in granolithic 2 inches thick.

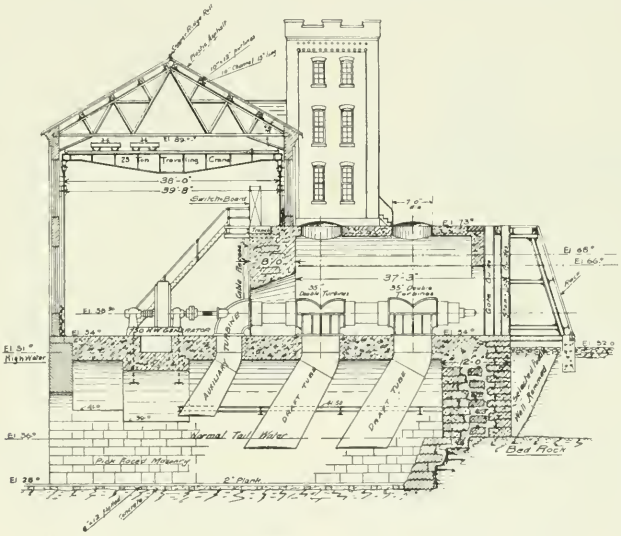
Flumes or Wheel Chambers.—The flume walls and arches and the bulkhead, between the flume and the power-house, will all be built of 1-3-5 concrete, carefully faced with cement mortar laid up against the forms. The exposed ends of the flume will be laid up in heavy ashlar masonry. Two large manholes with wrought-iron covers are provided in the top of each flume to allow of access to the turbines. The flumes have valves for admitting or drawing off water as required after the gates are closed. Heavy wing walls are carried along bank of head race and run well into the bank to form cut-offs.

Rack.—The rack framing is to be substantially built of structural steel. The rack is built of 3-inch. by ¼-inch. bars, spaced at 2-inch centres.

Gates.—Two gates are to be set for each flume. These gates will be built of oak and are to be made in two pieces; the outer half slides up or down over the inner half. This arrangement prevents having the gates stick up above the top of the flume and requires less power for operating. Stop-log checks are also provided into which logs can be dropped in case of accident to the gates.

Building.—The building will be a steel frame structure with brick walls. The steel columns will also carry girders and track for 25-ton hand power traveling crane. The walls are to be of pressed brick, and will be 16-in. thick with 3-ft. by 1-ft. 8-in. pilasters. The roof will be plastic asphalt with copper flashing and ridge roll. The building will be well lighted with numerous English sash windows, and large doors are provided for getting in machinery. Dry walls will be built out at each side of the power-house and the ground on each side levelled up to within 12-in. of the level of the power-house floor. An easy road will be graded up from this level to the top of head race bank, thus affording means of access to the power-house.

Turbines.—The turbines for the large units will consist of five 35 in. Samson turbines on a horizontal shaft. Four of these will run together at part gate during the period of normal tail water; the gate on the fifth or auxiliary turbine being closed by a hand wheel. When the head is reduced, the gates will be opened full and the fifth turbine thrown into service. The five turbines together will deliver 950 h.p. at 190 revolutions under 18-ft. head. The four turbines at normal head of 30-ft. will handle the load quite easily at part gate, and will be capable of taking care of a considerable overload if required. The gates, which are of the register type, will be operated by rods from a Lombard governor. These are so arranged as to do away entirely with any gearing in the flumes. The mechanism on the turbine case operating the gates is completely cased in and protected. The draft chests will be of cast iron made in sections to allow of removal for ready access to the runners. The whole of the work will be set on longitudinal I-beam girders set parallel to the shaft.



Milleroche's Water Power Development—Cross Section of Power House, (Section at A. B. in Plan).

The draft tubes will be of heavy boiler plate, and built flaring towards the bottom. They will be carried down far enough so that the ends will always be submerged. Heavy bracing is provided in the wheel pits to which draft tubes will be securely fastened, thus avoiding leakage in draft tubes caused by vibration and lateral movements. The head between power-house and flume will be of cast iron, in sections, securely fastened to a conical boiler plate shield having angle cut-offs to prevent leakage. The auxiliary turbine will discharge, through a quarter turn, the draft tube on this being shorter than required for the larger pairs for the reason that this turbine will not be used until the tail water rises 10 or 12-ft. A heavy thrust bearing is placed on the turbine shaft between the auxiliary turbine and the generator coupling. This will take care of any tendency for the shaft to move lengthwise. The exciter units will be two in number, each having a single 20-in. Samson turbine for direct connection to a 50 K.W. exciter. Either of these units can be cut out at will by

valves placed on the connection to feeder. The power-house is at present arranged for three units of 1,000 h.p., with exciter, but openings have been left for draft tubes, and arrangements made so that a fourth unit can be installed in place of the exciter which would then be belt driven from the generators.

ELECTRICAL EQUIPMENT.

The generators to be installed are of the rotating field type of 750 K.W. capacity, designed to deliver 3-phase currents at 2,200 volts. There are two exciters each of 50 K.W. capacity and either one is sufficient to excite the four generators which will make up the ultimate capacity of the station. Paper covered cables with lead sheath will be laid in ducts provided for the purpose from the generators and exciters to the switch-board gallery which overlooks the floor of the power-house, placing everything under the eye of the attendant and within easy reach for control of the apparatus. The switch-board is to be of blue Vermont marble on an angle iron frame and provides for control of exciters separately or in multiple. A generator panel will control the alternator and provisions are made for extending the additional machines by adding panels which will be practically the same as the first. Feeder panels will be added next to the exciter panels, and a separate switch-board for the series alternating arcs. Lead-covered cables will lead from the switch-board to the wire tower on the second floor in which will be located the station lighting arrestors, sufficiently removed from the switch-board attendant so as not to jar his nerves and prevent proper manipulation of the switch-board in times of heavy discharges. The step-up transformers of the air blast type are to be installed on the first floor of the wire tower, where the potential will be raised from 2,200 volts to 11,000 volts. The circuit wires fan out in both directions from the tower, which is located on the bulkhead side of the power-house about equal distance from each end, to heavy station poles, one of which takes the lines going west on the canal bank, the other going east. A fine line of cedar poles, nicely trimmed and painted, take the lines mostly along the south bank of the canal. The lighting and power lines are supported by the same poles, which are spaced about 100 feet apart, every fourth pole supporting an alternating enclosed arc lamp on the series system. The three-phase, 10,000 volt line, is tapped at each lock for connection to a transformer, which steps the voltage down from 11,000 volts to 220 volts, the lock master's cabin serving as a small sub-station from which is distributed all the current for power service at the locks. The arc lighting and power cables for crossing from side to side of the lock terminate at the switch-board in the terminal or cabinet houses. The locks are provided with from six to thirteen lights, and motors are provided for handling the sluice gates and for opening and closing the lock gates, as well as for control of the weir gates by which the levels of the different sections of the canal are regulated. The use of electric light and power thus makes the canals quite as serviceable by night as by day, and practically doubles their capacity besides handling the traffic more rapidly permitting the boats to make more trips in a season, which tends to reduce the cost of transportation.

The Wm. Hamilton Mfg. Co., of Peterboro, Ont., are contractors for the turbines, Lombard governors, and other hydraulic equipment. The generators, exciters and other station equipment will be installed by the Bullock Mfg. Co., of Cincinnati, Ohio. The Dominion Bridge Co., of Lachine, P.Q., are contractors for structural steel, traveling crane, rack, etc. T. Pringle & Son, Montreal, are engineers for the entire installation; F. H. Leonard, Jr., E.E., having charge of the electrical department, and Wm. I. Bishop, Assoc. Mem. Amer. Soc. C.E., having charge of the hydraulic and construction departments. The excavation, masonry, etc., is being carried out by the proprietor, M. P. Davis, who is one of the best-known contractors in Canada.

THE METRIC SYSTEM.

We have several communications on the subject of the Metric System of weights and measures. Two of our correspondents regret that we oppose the introduction of the Metric System into Canada. We regret that this meaning should be taken out of our article in March number, which was meant to enlighten the Toronto gentlemen who appear to think that all we need to do is to learn the metric tables and the whole thing is done. We wished to point out that in the engineering trades, particularly, a heavy expense is involved in changing machinery, tools, and stocks of goods, such as nuts, bolts, set-screws, etc., and that after all this is done, we have not got an ideal system of measurements. While we show this, we confess that the Metric System, with its admitted faults, is immensely superior to our own jumble of inconsistent and inconvenient weights and measures. That it is superior to the system, or lack of system, in use in Anglo-Saxon countries, is made evident by the fact that starting with France, a little over a hundred years ago, it has found acceptance in one country after another, till it is now used by forty-four nations with an aggregate population of 485,000,000. The associated Chambers of Commerce, of Great Britain, seeing how foreign trade has been slipping away from their country, owing to the increasing use of the Metric System throughout the world, and to the fact that once a country has adopted the system it never goes back to its own clumsy weights and measures, has at each annual convention for several years past, urged the adoption of the system; and, moreover, a special committee of the British House of Commons, in 1895, brought in a report recommending the change to the Metric System. The people and Government of the United States, realizing that their future foreign trade, too, depends on the adoption of a system which is already in use by almost every important non-Anglo-Saxon country in the world, except Russia—and that country also is coming into line—has ready a bill which is morally sure to pass at the next session of Congress, making the Metric System compulsory in the United States in 1903. The adoption of this law will simply compel Great Britian to fall into line, and Canada will have no other option.

In order to educate the Canadian public, and especially the engineering element of it, the publishers of The Canadian Engineer have prepared a metric chart, showing the meter in full size, and giving the principal tables and the key to the whole system on a single sheet. The fact that the entire system of metric weights and measures can be explained in five tables, on a single sheet, is, in itself, a proof of the simplicity of the system. This chart will be sold for office and shop use at the nominal price of 10 cents per copy, mailed free.

—In order to make the annual volumes of the Canadian Engineer correspond with the calendar year, the numbering and paging of the current issues will be continued till the end of the year, and the index will be issued to subscribers in December, when volume 8 will be closed.

—Capt. J. E. Bernier, whose plans for reaching the north pole have been described in this journal, is soliciting public subscriptions to defray part of the expense of building the polar research vessel he has designed. It is a pity that our Government, which can devote millions of dollars to constructing political canals, more millions to bonusing railways that need no bonuses, and still more millions to other deals of an equally doubtful character, cannot fit out a small ship for a public-spirited man who is willing to devote four or five years of his life to his country, free of charge, in a work which ought to be undertaken gladly as a duty by the Canadian Government. No country in the world has so practical an interest in the exploration and navigation of the polar seas as Canada, especially when this exploration affects our own interior, and it is amazing that both the members of the government and the average of our members of parliament are so dead asleep to the importance of solving the problems of navigation in frozen waters. Even if Capt. Bernier fails to reach the north pole, such a vessel can be turned into excellent use as an ice-breaking boat, or used in government investigations in the Gulf of St. Lawrence or Hudson Bay. We trust the government will be shamed into doing the proper thing by Capt. Bernier's enterprise, and that in the meanwhile the public will come to his aid by subscriptions. We understand about $60,000 will be required to supplement the paltry aid promised by the Dominion government. Subscriptions can be forwarded through the Canadian Engineer.

ENGINEERING ETHICS.

The following are the corrected remarks made by Professor Galbraith at the last annual meeting of the Canadian Society of Civil Engineers, respecting Engineering Ethics: "Professor Galbraith thought that an engineering professor should be free to accept any employment or work in which from his experience he might be looked upon as an expert. At the same time he was opposed to an engineering professor making a business of doing ordinary professional work."

BUFFALO RAILWAY CO.'S POWER PLANT.

Though not strictly a feature of the Pan-American itself, there will be located a stone's throw from the Exposition grounds a plant which will be well worth the inspection of the visitor interested in mechanical subjects. We refer particularly to the large plant, which is being constructed by the Buffalo Railway Company for the purpose of furnishing power to aid in the operation of its street railway lines during the Exposition period, when a great increase in its traffic is to be expected. One of the features of this plant will be the installation of a large mechanical induced draft fan to produce the draft, and handle the gases of combustion from a boiler plant whose nominal capacity will be in the neighborhood of 3,000-h.p. The fan in question, built by the Buffalo Forge Company, of Buffalo, N.Y., is 24 feet in diameter, of the three-quarter housing up blast type, and rigidly constructed of steel plate, braced and stiffened with angle irons. The fan is designed as an exhauster with an inlet 9 feet in diameter and will be driven by belting to a Buffalo 13 by 12 horizontal centre-crank class "A" engine. In order to keep the bearings cool, a constant circulation of water will be maintained around them. The short stack into which the fan will discharge, will be of sheet steel. This particular plant illustrates very nicely some of the inherent advantages of mechanical induced draft. For instance, there is no necessity for a tall heavy chimney, and again, since the whole construction is of steel plate it can be constructed and installed in a minimum length of time. Once in place, such an apparatus provides complete control over the conditions of combustion and renders the performance of the boilers independent of those conditions of weather, wind, temperature and the like, which influence plants served with chimneys. The intensity of the draft is in proportion to the fan wheel velocity, and hence can readily be altered to suit varying conditions.

BORING TOOL HOLDER.

This tool is designed for boring and inside threading, and will be found very useful for these purposes. The holder is made with a groove both top and bottom to facilitate the holding of tools of different sizes. The shank is made of crucible steel; the yoke being milled from solid bar machinery tool steel, and the set screw of best quality tool steel. When the tool is inserted in the holder, it is held in place by bring-

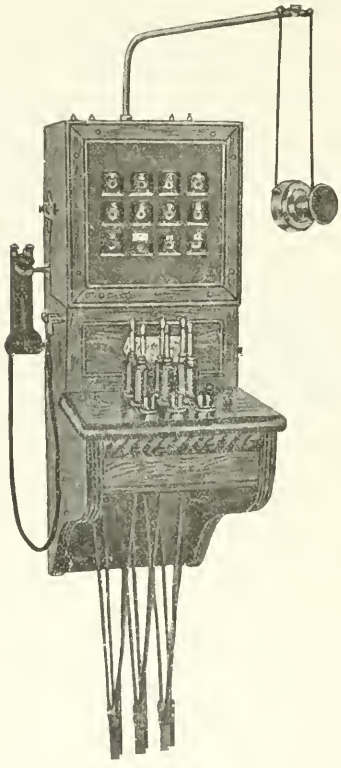
ing down the set screw. The holder being put in position in the tool post is held firmly by bringing down the tool post screw, and becomes perfectly rigid. The holders are made in four sizes. Tools are not supplied with this holder by the Keystone Mnfg. Co., of Buffalo, who are the manufacturers, but they will be pleased to furnish further information to our readers.

LUBRICATING A HIGH SPEED ENGINE WITH WATER

A correspondent sends us the following item with the remark that it shows what can be done with large and accurate bearings, and that the idea of water as a lubricant is a step in advance of English or American engineering practice: D. R. Munro, of Wolfeville, N.S., at the request of a St. John engineer, furnishes The Sun with an account of his experience in running an engine with water as a lubricant: "I have been running our 125-h.p. Leonard peerless compound engine (self-oiling type) for over five months with nothing but water to lubricate the main working parts. It came about partly from experiment and partly from necessity, being short of oil at the time. The results have been most remarkable and satisfactory. Before using water I was obliged to adjust the engine occasionally, particularly the wrist pin, quite frequently (which is a weak point in any engine). Now since water has been used as a lubricant there has been no adjustment whatever for five months, and to-day the engine is running perfectly, although very heavily loaded. I am quite sure the idea is entirely original, and anyone using water instead of oil in this type of engine will never use oil again, as water is so much less trouble. When using oil I found that the churning it got caused it to disappear in the form of vapor, I suppose. This is how I began to use water to raise the oil in the reservoir after it had become so low that the crank discs would not touch it. I kept on adding more water when necessary, until the oil entirely disappeared and left nothing but water. Another good feature is that while the oil continues to grow less, the water, on the other hand, accumulates, due to drip from piston rod, so there is no possibility of the engine running dry. I was somewhat anxious about rusting at first, but find all the parts remain perfectly clear and bright."

THE MODERN TELEPHONE.

So accustomed has the general public become to the telephone that scarcely a thought is given to the advancement of this important factor in present-day business methods. The telephone now covers so broad a field that it might be well to consider, separately, a few of its many modern applications. For many years the fundamental patents underlying the telephone and its operation were controlled by the Bell Telephone Companies operating in the United States and Canada, but by the expiration of these patents, a new field was opened up to the inventor, as a result of which, and through the efforts of the many companies now engaged in its manufacture, the tele-

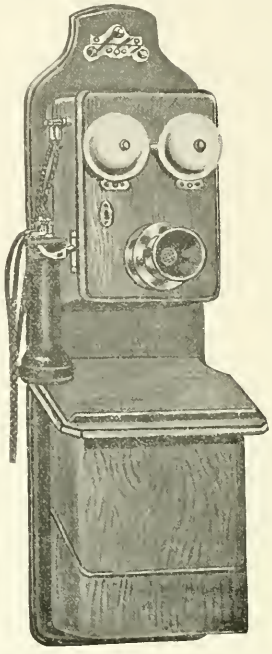


phone has now been brought to a very high point of perfection.

Long distance telephony has worked a great revolution in the past few years, in that it has rendered possible the transaction of business between distant points, which formerly necessitated long and expensive railroad journeys, incurring much inconvenience and loss of time. Now a man may sit at his desk, and in a few moments accomplish the same results by means of the telephone.

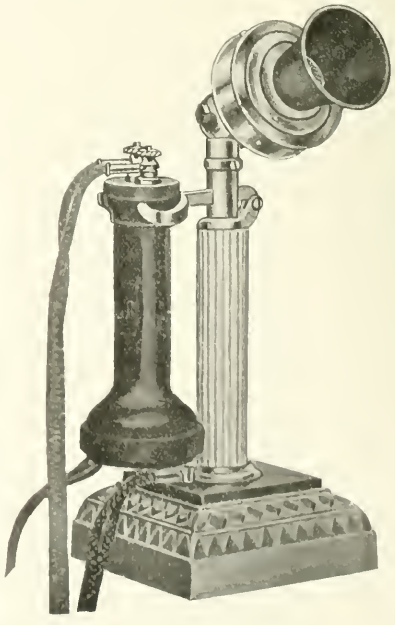
The use of the telephone in connection with the Central Exchanges in cities and towns is too well known to require comment, but it may be remarked that competition has lately become very keen in this direction between the Bell and the independent companies, as may be attested by the enormous increase in the number of private exchanges installed and operated by independent companies in the United States, Europe and Canada within the past few years. The inter connection of these private systems is offering an excellent means of establishing independent long distance lines.

In rural districts the "party line" system presents a very effective but inexpensive method of connection between a limited number of persons, although by the use of a small switch board at some convenient point the number of connections may be increased indefinitely. Thus, it may be seen that, beginning with a short party line with perhaps but half a dozen subscribers a system may gradually be developed which would cover a very large area, and furnish connection by telephone between hundreds of persons, and with many adjacent towns or villages. This system is finding great favor with farmers and others, owing to its simplicity and convenience, coupled with its extremely low first cost. Interior telephone systems



have of late come into very extensive use, their many advantages being easily recognized when their operation is explained.

A manufacturing establishment or a large warehouse may be fitted with what is known as an inter-communicating telephone system, which places the office and all departments in



instant communication with one another without the use of a central station, each instrument being fitted with its own selective switch. When it is considered that the manager or superintendent of a busy manufactory may sit at his desk and

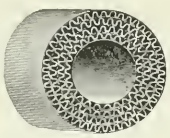
give directions to the foreman of a distant department, it will easily be seen that such a system would in a short time pay dividends on the cost of its installation. The time spent by a department foreman in running to the office for information which might have been given over the telephone, is alone an item worthy of consideration. Contrary to the general idea, these systems are inexpensive, but their advantages are decidedly marked.

Modern hotels are now installing an interior telephone system in connection with their electric bell systems. A small telephone set, designed for the purpose, is placed in each room and connected with the office, where a guest's requirements may be made known without the employment of the usual "bell boy." Guests may also converse with one another without leaving their rooms, through the medium of the small switch-board placed in the office. The convenience and advantages of this system have recommended it to hotel proprietors and managers, and its universal adoption will soon result. Many other uses to which the telephone adapts itself will readily be suggested, and it may be seen that the usefulness of this instrument is every day increasing.

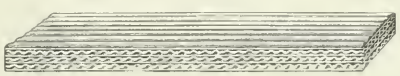
The telephones and small switchboard here illustrated, are the product of the Colwell Mnfg. Co., of Toronto, who make a specialty of these independent systems, and who can give information to those interested.

AMBLER ASBESTOS AIR-CELL COVERING.

The Ambler Asbestos Air-Cell Covering is manufactured of asbestos with longitudinal sections of parallel trapped air cells, and is claimed by experts to make the most perfect insulation. The saving effected by this covering on pipes previously uncovered is surprising. The loss on 1 foot of 2-inch



bare pipe at a pressure of 60 lbs. is estimated at over $1 per annum. By the use of the Ambler covering a third less coal is used, and the user has dry steam. This saving on the cost of fuel will soon more than repay the outlay on the covering used. One great advantage this covering has over all others



is, its absolutely fire-proof construction, the peculiarly trapped air-cells make it unusually strong, very light and mechanically perfect. This, the makers claim, is not an experiment, but a proven fact, as it is now extensively used throughout the United States and Canada by the largest steam users. This covering is made in three thicknesses. Class A, 1-inch, for

high steam pressure, B, ¾-inch, for low pressure, C, ½-inch for hot water. It is also made in blocks, boards and rolls for boiler use. For prices and printed matter, write the Fairbanks Co., 749 Craig street, Montreal, they being Canadian agents for these goods.

The Dominion Cotton Mills Co. have under considerat on plans for the enlargement of their factory in Halifax; but the matter depends upon the extent to which they are granted exemption from taxation.

PORTLAND CEMENT.

An instructive talk on "Essential qualities required in specifications for cement," was the feature of a recent meeting of the Engineers' Club of Toronto. M. J. Butler, C.E., chief engineer for M. J. Haney, C.E., formerly with the large cement works of the Rathbun Co., Deseronto, led the discussion. In his statement of the proper requirements in specifications for cement Mr. Butler said that although for the past twenty years, papers by experts dealing with this have appeared, much still remains to be said and done before a perfect specification will be had. In the hope of assisting to throw some little light upon the questions, he ventured to submit the scheme outlined below; believing that such a division substantially includes all that it is needful to know about a cement in order to confidently use it on any work. Much of existing requirements found in Portland cement specifications and text-books is due to the fact that all of our accumulated data is based on English sources, where coarse grinding and unscientific raw mixtures are the rule. The clause requiring a considerable increase in strength between say 7 and 28 days was framed by the late Henry Faija, and was no doubt a good one, having in view the coarsely ground cement then in use. The fixing of a rather low tensile strength at the earlier period was a simple recognition of a state of existing facts. Now that cement is so finely ground, and hence in a condition to reach an active state almost at once, he failed to see why any engineer should object to a high tensile strength at an early period. If we can secure 90% of the strength in one month, why object to it? The following table shows the chemical composition generally considered to be requisite for a good Portland cement:

Lime (calcium oxide)	58 to 65%
Silica	20 to 26%
Alumina	7 to 14%
Magnesia	1 to 3%
Akalies	traces to 3%
Sulphuric acid	traces to 2%

SCHEME FOR PORTLAND CEMENT EXAMINATION.

1. Form and fineness of grain.
2. Color and specific gravity.
3. Time of setting.
4. Hardening.
5. Strength.
6. Constancy of volume.
7. Hair cracks and shrinkage cracks.
8. Behavior under extreme heat and cold.
9. Additions and adulterations.

(1) Under the microscope the grains of a well made Portland cement are flaky, of a thin leaf-like scaly structure, and this form seems to be required to secure that close adherence so characteristic of good cements. Fineness is one of the most valuable characteristic qualities a cement can possess. The fact is that in order to be active it is essential that it be fine. To any of you, familiar with chemical work, it will be obvious, that, in order to secure results, the first preliminary is to reduce the material under examination to a minute degree of sub-division in order that the re-agent may take hold of the substance. So in making a mortar, the chemical forces at work are influenced by the fineness of the active material, viz., the cement. When sifted through a sieve of 10,000 holes to the square inch the residue should not exceed 10%, and when through the 40,000 sieve the residue should not exceed 15 to 20% in the case of Portland cement. In the case of sand cements the fineness should be on 10,000 sieve not to exceed 5% residue, and of the 40,000 sieve not to exceed 10 to 15%. The finer the grinding the better.

(2) Color.—The color of a good Portland cement is ordinarily of a greenish gray, but brownish spots are not necessarily due to under burnt material. It may be due to over-burnt clinkers burned with too much sulphur in the coal. The rotary kiln produces a peculiarly dark, greenish glistening clinker. The old-fashioned bottle kiln, using coke for fuel, produces the color, which finds a place in all the text-books and in most specifications in use in this country. The continuous burning type of kiln illustrated by the Dietzsh & Aalborg, using coal for fuel, do not produce a clinker of the same color, although the resulting cement is chemically and mechanically alike, hence

upon the manner in which the clinker is burned will depend, within limits, the color of the resulting cement.

The specific gravity when accurately and thoroughly taken is a valuable test indicating the proper density of the cement. It may vary in fresh Portland cements from 3.08 to 3.25, and ordinarily should be about 3.10. The determination is one requiring care and skill in order to secure results of value. Old cements invariably show a lowering of the specific gravity.

(3) Slow setting cements are, for general work, the safer and more reliable, a quick setting cement is apt to be a dangerous one; three to four hours for the initial set, and six to eight for final set will ordinarily suit most works, freshly ground cements will always set more quickly than those in store for some time, hence there is apt to be some unhydrated calcium oxide in quick setting Portland.

(4) Hardening should not be confused with setting, as it begins when the latter leaves off. For proper hardening the work should be left undisturbed, and with plenty of water; drying out quickly often ruins a good piece of concrete; so too a senseless picking at new work, a fault often witnessed. Leave it alone a reasonable time with sufficient moisture to allow the chemical action to go on. Good work will continue to harden for a whole year.

(5) The custom has grown up to test cement purely in tension, although good reasons might be shown why it is preferable to test in compression. The ease and certainty with which tensile tests can be made probably account for the selection of this form. Transverse tests are more difficult to carry on as a slight flaw in the sample unduly affects the result. A good Portland cement when tested neat, should at the end of 7 days, 1 in air, 6 in water, show a tensile breaking strain of not less than 450 lbs. and at the end of 28 days not less than 600 lbs. to the square inch. A sand mortar test is, however, a much more practical one and shows better the real value of a cement. Standard sand (crushed quartz sifted through a 400 sieve, and using what remains on a 900 sieve), should be used for comparative purposes. It is hard enough to get comparative results with different brands of cement without introducing the additional complexity of varying sands—hence the necessity for a uniform quality of sand. It is by no means a strong mortar. As to secure the best mortar, a varying size of grain in the sand is what is required, he was led to enlarge somewhat upon this point, as twice or three times during the past year he found engineers specifying that the sand to be used on large works should be of such a grain that all the materials should pass the 400 sieve (20 x 20), and use only that retained by the 900 (30 x 30) sieve. No doubt, finding standard sand specified for comparative purposes in committee reports in testing cement, and failing to appreciate the purpose in view, they have concluded that such sand must be the best. Well, it is not; ordinary pit sand will make a much stronger mortar.

(6) This test is in Mr. Butler's judgment at once the most practical, easiest to carry out and most valuable in the list, but requires to be carefully done. He ventured to submit the following directions: 1st. Select a small strip of plain glass, about 3-in. by $1\frac{1}{2}$ in.; wash it clean; mix the cement neat, working it up into a stiff mortar, trowelling it well on the glass, the briquette will be about half an inch high in the centre and be worked off to a knife edge at the edges of the glass, forming a flattened pyramid. All the air should be worked out with the trowel, and all surplus water. Spend time enough to do the work well. Cover with a damp cloth to preserve the sample from drying out; leave in the air until set, generally 12 hours; then place in a damp atmosphere or vapor over hot water in the hot bath tank—water heated to 130 F., where it should remain for 12 hours longer. Then place in the hot water and steam it for 24 to 30 hours. If a new untried cement raise the temperature gradually up to 170 F. If the sample remains true and straight and free from cracks there is no free lime present, in a form that will injure the cement or mortar. Sometimes it is found that although the sample is hard, strong and bright with a crisp ring, it should that it breaks the glass and an explanation was asked as to why this should be. The following solution is suggested: The sample generally is lying around for some time exposed to varying temperatures, the chances are the glass is a very hard piece, and one slightly porous and roughened, so that the briquette adheres very strongly to it. Now the co-efficient of lineal expansion of pure Portland cement is for one degree Fahrenheit in a length of one, 0.00000594, and for glass of the kind above assumed, 0.00000397 in other words, and neglecting the cubical effect of the greater mass of concrete—the expansion of the concrete for a given change of temperature is probably twice that of the glass. This explanation also suggests the reason why sound cements quite frequently leave the glass altogether. Care should be taken in examining briquette to distinguish between expansion cracks due to free lime and those sometimes witnessed due to mere drying out, or insufficient trowelling.

(7) Hair Cracks and Shrinkage Cracks.—Portland cement mortar exposed to air diminishes in volume. If drying takes place gradually no defects will appear, but if allowed to dry rapidly, or in a draught of air, or in sunshine without taking the precaution to keep it moist the so-called shrinkage crack appears. Hair cracks as seen on pavements and piers are generally, if not always, due to using too rich a mortar, and are caused as above described. The remedy is use more sand for such surface work.

(8) Under ordinary temperatures cement is unaffected to any appreciable degree; a good cement will stand boiling water; but in extreme cold chemical action is suspended, but between the freezing point of mortar and say a temperature of 400 to 500° F., cement mortar will behave in the ordinary way—higher temperature accelerating the set of the mortar, lower temperature retarding it. At extreme high temperatures he believed Portland cement concrete will disintegrate and fly to pieces, particularly if drenched with water; hence he regarded it as an unsuitable material for fire-proof buildings.

(9) The adulterations usually found are slag and some form of finely ground limestone or rag-stone. He had reason to believe that the exacting of a pearly gray color has had something to do with the adding of such materials. Such adulteration within reasonable limits, if the material is finely ground, is not a detriment to the cement—on the contrary it seems to increase its strength.

C. B. Smith, C.E., formerly assistant professor in McGill University and having charge of the cement testing laboratory there, said they had all listened with interest to Mr. Butler's remarks, as he spoke from an experience and knowledge, both as a manufacturer and user. There were some points that had arisen lately in cement testing which were startling, perhaps alarming, although the future alone could prove this. Regarding specific gravity a demand for a value of 3.10 or over had in the past been considered strict, while now the manufacturers produced a cement by rotary kilns of a specific gravity of 3.25 (when fresh), which according to standard authorities indicated overburnt clinker. Was this true? or did it merely indicate a more thoroughly uniform burning with an absence of underburnt particles? This is a problem that chemists must aid us in solving. Then, also, in neat tensile tests a demand by engineers for 400 lbs. per square inch in 7 days was met by manufacturers making an article testing 600 to 800 lbs. per square inch in 7 days, and practically never getting any stronger, in fact, usually getting weaker in six months or a year. Although sand tests had not indicated any falling off in strength in one year tests, in any that the speaker had ever made, yet this might come later, in several years perhaps. About four years ago, while in charge of the McGill cement laboratory, the speaker had a complete series of samples made, on which to make tests from one week to ten years, and he hoped as years went on to have some long time tests to examine which might give valuable information. Probably the outcome may be to restrict the manufacturer by prescribing maximum as well as minimum tests, in order to prevent the making of a brittle material. The following test the speaker considered was the most important test of all. Soundness is the essential quality. What engineers want to feel is that their works will endure, not for 10 or 20 years, but for hundreds of years, like the structures of earlier days built by engineers, not of an age of so-called "science," but of the dark ages. During the last year he had some comparative tests made in the Toronto City Hall laboratory, which gave the following results:

Name of soundness test	No. of tests.	Failures.	Medium.	Absolutely sound.
Dr. Pruessing's	44	5	11	28
Dr. Michaelis' (boiling)	44	3	6	35
Faija (hot water)	44	2	2	40
German standard (1 month cold water)	44	0	2	42

The first test is a very severe one, practically a fire-proofing test, and perhaps it may be asking too much to demand conformity to it but the use or rather abuse of sulphate of lime as a regulator of the time of set, has enabled the manufacturer to conceal the presence of free lime, from even the hot water test, although it may be undeniably present It remains for users of cement to do one of three things, admit defeat, devise a simple method of making a satisfactory blowing test for soundness or what is probably the most feasible method, regulate the amount of adulteration of sulphuric acid by specification and analysis. Mr. Butler perhaps could tell us whether the use of slack coal as a fuel had contributed appreciably to the amount of sulphuric acid in a cement or not. [Mr. Butler—"It has"]. Because in several analyses which were made of Canadian and American cements this year the percentage of sulphuric acid was high, running up to 2¾% (equivalent to say 5% sulphate of lime). This indicates a very unsatisfactory state of affairs. Other noteworthy features of these analyses were that the percentage of CaO only averaged 55 to 62%, and the carbonic acid 2 to 11%, which latter would indicate quite an amount of unburnt clinker or addition of ground limestone after burning. Now, to most engineers, simple tests are the only ones available, and chemical ones may seem not only costly but out of reach, but it is probably the future means of more certain control of the product than any other, and should be more carefully studied and practiced where possible. With reference to frost tests and use in cold weather, while laboratory tests which were made on cold materials exposed at once and left out all winter in Montreal climate gave very good results, equal almost to ordinary laboratory tests; yet in practice difficulties and failures occur. For instance, in Toronto, a concrete abutment laid in frosty but not severe weather scaled off in large patches for say ¼-inch deep on portions of abutment laid with one brand of cement, but with portions laid in similar weather with another brand the surface was smooth and hard. One brand of cement satisfactory in summer for concrete foundations has proven unsatisfactory in cold weather, late in fall, etc. Showing that many little practical features may affect theoretical results deduced from one or two brands of cements only.

In reply to a question regarding the reason for not adopting transverse tests which could undeniably be made with simple machinery, the speaker's experience has been that the strength of specimens was so erratic, being affected by the presence of the least flaw on the tension face of the specimen, as to preclude its usefulness as a method of testing. Tensile strength forms a satisfactory index of compressive strength also, and is made by simple machinery. It is adopted all over the cement testing world, and thus provides a mass of data to base knowledge or specifications upon that could not in any case be easily cast aside, even for a slightly superior method of making tests, which, however, has not yet been discovered. Fineness of grinding is a matter of dollars and cents; a continual advance is being made, but too exacting a specification would restrict competition and defeat the end in view. The manufacturers are alive to the value of fine grinding and are making steady progress. At present 10% residue on No. 10,000 sieve is as fine as any, but Canadian or American cements are ordinarily ground, and about fixes the limit of open competition.

R. B. Rogers, of Peterboro, and John Lucas, of Toronto, agreed generally with the deductions of the speakers. The former thought too much stress had been laid on changes in the methods of manufacture. He found the samples tested on the Trent Valley Canal went on increasing in strength for a month, but after two to four years they became weaker.

Mr. Haney questioned whether tests were carried over a sufficient length of time. He found the maximum strength was attained in a short time, but it was to be shown whether deterioration set in after that.

The president (A. L. Hertzberg), asked whether roasting by rotary or stationary kilns was a matter of choice or a question of cheapness.

M. J. Butler replied that it was a question of efficiency. With the rotary kiln the manufacturer could adjust and regulate the heat to a nicer degree, and keep the process of burning under better control with consequently better results.

E. H. Keating said engineers ought to have a more ready method of testing cement; they had not the means or time to determine all these points while work was going on. Some years ago while carrying out work for the city of Toronto he had to stop work altogther for six days in order to find out the quality of a certain cement introduced.

Prof. Wright said they had been speaking of tensile strength alone, and had not attached sufficient value to compressive strength. Compressive strength did not drop as tensile strength did.

Major H. A. Gray in his work appreciated the difficulty mentioned by Mr. Keating, that of loss of time in making these tests while work was pressing. He suggested the inspection and testing of cement by government and the branding or certifying of barrels that had passed examination.

E. J. Philip asked if cement would set when it had frozen.

Mr. Butler—No.

Mr. Philip understood that at Sault Ste. Marie concrete and cement work was carried on all winter, the only precaution taken being that it was kept from the sun. He had some work built in Toronto in winter, and all the provision made was to see that frost did not get at it during the first few hours. Afterwards it froze without any apparent harm.

Mr. Butler said salt was often added in cold weather to lower the freezing. In reply to Mr. Philip he said water containing clay in solution often spoiled the setting of cement.

The president said that generally speaking it was a mistake to lay cement in very cold weather, but he had often done it with good results.

Mr. Haney said that when mortar was frozen continuously till it dried there was no harm from frost, but the damage was done by alternate freezing and thawing. With regard to sand it must be remembered that different qualities of sand gave different results, and there should be tests of the mortar as well as the cement.

Willis Chipman attached a good deal of importance to the points raised by Messrs. Keating and Gray as to some means of a quick setting test. In case of accidents where repairs had to be effected at once—as in waterworks—it was a great thing to know at once if a material is safe to use.

ELECTRIC RAILWAYS OF CANADA.

The interesting statistics prepared annually by George Johnson, Dominion statistician, on electric railways of Canada are brought down to the end of last year. From these it appears that at the end of December, 1900, the number of miles of electric railways in Canada increased to 681 miles, or 49 miles over the number in 1899. The 35 electric railways in Canada carried 118,129,862 passengers in 1900, an increase of 14,097,203. This is equal to carrying every man, woman and child in the country 21 times. The car mileage run was 30,924,355 miles, an increase of 1,277,508 miles over 1899. The mileage run and the passengers carried show that for each mile run the roads carried 3.8 passengers, against 3.5 in 1899. The amount of paid up capital invested in electrics on 31st December, 1900, was $20,633,000, and the bonded debt was $12,619,422. The number of cars in active service in 1900 was 1,642, an increase of 98 over the previous year. The employees numbered 4,493, showing an increase of 164 over 1899. The total receipts for the year were $5,422,540, and the expenses $3,268,001. The steam railways carried 17,122,103 passengers in 1900, so that the total number of passengers transported by rail was 135,252,055. Between them the steam and electric railways carried the whole population of Canada 25 times in the year, and the proportion was a little over 87 by electric and a little under 13 by steam in every hundred persons carried. Since 1897 the number of passengers carried by the electric railways increased from 83,811,000 to 118,130,000, an increase of 34,319,000, which is equal to 41 per cent, while those carried by steam using rail

ways increased from 13,742,454 to 17,122,193, an increase of 25 per cent. The expenses form about 67.50 per cent. of the gross earnings of the steam-using railways, and about 60.27 per cent. of the gross earnings of the electric railways.

In addition to the motor cars there were 324 trailers, of which 219 were used by the Toronto Electric Railway. The number of transfers given in Toronto last year was 12,570,000. Neither in the case of Toronto nor of any other city are the transfers counted in the number of passengers carried. The Montreal Street Railway carried 36 per cent. of the whole number of passengers. The Toronto Railway carried 30 per cent., and the Ottawa Railway 6 per cent., these three being far beyond any of the others.

CONSTRUCTION METHODS IN CIVIL ENGINEERING.

ILLUSTRATED BY DESCRIPTIONS OF TYPICAL METHODS OF BRIDGE ERECTION.

BY FRANK W. SKINNER, C.E.*

Originally the civil engineer was conspicuously a practical man without collegiate and generally with little mathematical or scientific training; he was a master mechanic, a skilled constructor, who developed the crude elements of design, formulated approximate strains, and executed his work chiefly by great judgment, skill of hand, experience, intuitive perceptions, and a genius for handling men and materials. These men had no elaborate plant, nor special tools, no steam, electric, pneumatic or hydraulic power machines and few established methods of operation or precedents. The solution of their problems was to make the work so massive and simple that it could be accomplished by unlimited expenditure of time, money, labor and material.

Now, the conditions are opposite; the engineer is required to execute much more hazardous and infinitely more elaborate tasks in safety, with the least possible cost and with the utmost precision and rapidity, and in keen competition, with slender margins for profit or allowance for contingencies.

To do this work he is trained in advanced technical schools to be an expert mathematician, chemist, metallurgist, draughtsman and mechanic. He is instructed in the principles and details of design, has examples and criticisms of typical structures, is taught how to analyze practical questions, and apply scientific principles to direct and control nature's forces for his own practical operations on a large scale; he is practised in tests and experimental and actual work; he has in many curriculums a valuable course for field work in surveying and railroad location, and in most good schools may readily learn to know something about everything, and everything about something; that is the foundation upon which he enters the world to commence to be an engineer in some chosen field. So much is indispensable.

One graduate is simply on a level with many others from the numerous good institutions that prepare scores of rivals for him every year, he must compete with them for the positions that are daily scarcer, and if his Alma Mater can give him a single special advantage, it will benefit him and it equally. There is probably no single kind of constructive engineering in which the college student knows the general processes, details and machinery employed in carrying out the execution of the design. He does not know the progressive steps in laying out the work or the simplest accepted methods of handling it. He does not know the details of sinking the shaft, arranging his pumps, installing his air locks, tunnelling his rock and handling soil, blasting, or operating steam shovels. He does not know how to carry down his pits in wet soil, protect his excavations, lay his brick inverts and arches, mix and distribute his concrete, or advantageously erect his derricks and arrange his track system.

He would be utterly at a loss how to take the carloads of massive steel bars, posts and girders from a confused pile on the mountain side and assemble them into a connected framework spanning a deep and wide gorge with its furious torrent or treacherous bottom, where the building of the staging is the most perplexing difficulty, nor would he be able to replace a railroad bridge by a new structure in exactly the same position without jeopardizing or interrupting the traffic. He does not know how to rapidly remove a large city building, excavate deep pits in crumbling earth without undermining adjacent towers, sink enormous foundations, run lofty tiers of columns and span them with wide roofs without injury, damage or obstruction to the thousands of people in the street above and below him.

He has been well taught to survey his road, align his tunnel, proportion his wall, calculate the foundation pressures, design and compute his pumps and engines, proportion his trusses, analyze the strains, choose the details, check the clearances, compute the strain sheet and design and estimate the finished structure, but this auxiliary work is beyond his field, and the result is that his designs may be theoretically correct and practically impossible, while from the lack of elementary practical intelligence and familiarity with general methods, he is unable to fill many positions where he would otherwise be valuable.

It is true that he is not likely to be trained in all kinds of field work, but if he becomes a successful specialist in any branch he will need to know its details thoroughly and a general intelligence and outline knowledge of the principal divisions of field work, methods and standard equipment will be of great value to him, and if he can secure it for reference, and comparison, it would facilitate his progress directly and comparatively.

No sustained or comprehensive instruction in this direction has ever been given to students—it has not, indeed, been collated or formulated so as to be available for them, since their regular instructors are necessarily theoretical and scientific experts.

The most that has been done is the presentation, in several high-grade colleges within the last ten years, of irregular single lectures, by different, more or less, prominent engineers and specialists, on miscellaneous practical subjects, usually either a special class of work they have performed, or a general description of a single job. Doubtless the lecturers are distinguished and able, and the more they are so the less they can afford to spend much time and labor in condensing and explaining and preparing special drawings, etc. No text book or general treatise, or even collection of special descriptions of work has ever been published.

The men who have handled most of the details of the most numerous examples of work are uneducated, foremen and superintendents, guided by precept and experience and entirely incapable of writing succinct descriptions, or preparing notes and sketches. Much of the work that has been executed is unrecorded, except in private and unavailable memoranda, and the principal sources of available data are the files of leading technical journals, engineers' official reports and private records, and the proceedings of technical societies, all of which are disjointed and heterogeneous, and have never yet been collated, classified, expanded and published systematically.

It is however possible, from a sufficiently abundant collection of progress views of all kinds of field work, executed since the era of dry plate photograhy, extended by personal and professional contributions of notes and data, and methodical abstracts from foreign and American papers and periodicals for a considerable number of years, to secure material for a series of descriptions and illustrations that will embrace most of the standard and notable works of field engineering, and arrange them so as to form divisions comprising the principal classes of operations and show the methods generally employed, their general nature and essential details and the special apparatus and standard machinery, so that it may serve for precedent or basis of comparison and investigation for other work and yet be within suitable limits for the engineering student.

Such a feature in the technical curriculum would be entirely new, without being radical, and would be extremely difficult to readily copy or parallel elsewhere, since it demands a familiarity with the unwritten work and a comprehensive and varied collection of data that must be gathered from a wide circle of specialists, expanded and completed by personal familiarity with the work and visits and investigations at the sites, and finally condensed and analyzed with regard both to its practical and theoretical value.

* A paper read before the Applied Science Society of McGill University and published exclusively by the Canadian Engineer.

Such data has been prepared by the writer and presented recently to the undergraduate of some colleges, in a series of illustrated lectures giving precedents for different methods and constructions for various classes of operations; notable examples of important domestic and foreign works; views of the progress and successive stages of work; examples of standard apparatus and plant; details and general plans and outlines of the structures; descriptions of notable, peculiar and important work, explanations of its essential features, advantages and governing conditions, and of the elements of economy, success and failure, with classified references to most of the available authorities.

This course includes about twenty lectures, including five on the erection of different classes of bridges and the recognized types of erection methods, two on erecting steel buildings and roofs, four on sinking shafts and driving tunnels, two on rock and earth excavation and handling (essentially canal building); others on building pipes and conduits, masonry arches and sewers, on building foundations and bridge piers, breakwaters, great masonry and concrete constructions, submerged work, caisson and cofferdam work, moving and underpinning houses and other kinds of important work.

Illustrations and selections from each of these divisions of field engineering would be interesting, but their most condensed description would extend far beyond present limits, and it will suffice to indicate the character of one branch of the work by examples of some methods for erecting steel bridges, not only because bridge erection is one of the most important classes of engineering, but because it is thoroughly typical of the methods and plant used for all kinds of steel structures, and because steel is becoming universally an element of prime importance in the skeletons of all large structures, from tunnels to waterworks.

A great bridge span consists of hundreds of tons of massive beams, girders, struts and bars, which have, perhaps, been built in several remote shops and shipped from them without having been assembled together, to the site in a wilderness many miles from shops or tools or any skilled labor. There the erector comes to find scores of carloads of great beams and bars and posts and chords and pins and boxes of bolts and rivets, piled in apparent chaos on the banks of a great precipice, beside a rushing mountain torrent, or by a river flowing over treacherous quicksands or with waters of great depth and swiftness, or subject to dangerous floods, sweeping ice, or perhaps under restrictions not to impede the navigation and to maintain traffic on an old structure on the very site of the new one.

To accomplish these ever-varying but never light tasks, he has a few carloads of ropes and pulleys, some thousands of feet of timber, bolts, etc., plenty of hand tools, some special hoisting engines and from twenty to one hundred skilled bridge erectors. With them he weaves the huge rigid bars and beams into a self-sustaining truss hundreds of feet high above the torrent, handles the 50,000-lb. pieces 50-ft. long, high in air, fits them together like wheels in a watch, bolts, rivets and adjusts, and in a few weeks, often without the loss of a life or of a pound of steel or a foot of timber, has built a temporary bridge to work on, has completed the permanent structure above it, has maintained traffic and navigation, and has removed all his auxiliaries and departed to provide an entirely new solution for radically different circumstances at the next place.

Each large bridge is a new and separate problem, and is solved with great courage, resourcefulness and ability by the bridge erector, but as the design of bridges has crystallized into certain well-recognized types, different in proportion and detail for every case, so their erection has come to be usually effected by one of a number of general methods modified according to the requirements of each case and executed with a certain standard line of plant and machinery.

The most simple and direct method of erecting a long span bridge, where it is not too high above the water, and the water is not too swift or deep or the bottom unfavorable, and where the dangers of ice and flood and the restrictions of navigation and traffic do not prevent it, is to build it on trestle falsework, i.e., to make a temporary timber platform on trestle bents, usually of piles, and support the structure on that until it is complete and self-sustaining. The different members of the trusses are usually assembled by numerous sets of tackles suspended from a movable wooden tower or traveler built to run back and forth on top of the falsework, clearing the bridge span.

One of the most interesting of bridges erected on such false work is the Poughkeepsie double track bridge 6,800 feet long, and 130 feet high, across the Hudson river. It has three cantilever spans about 550 feet long and two 525 foot connecting spans, the latter erected on some of the handsomest falsework ever built. The piles were 120 feet long, each made in two pieces spliced with butt joints and fish plates. Single pieces weighed 34 tons each and had to be lifted 150 feet high. Forty-two sets of tackle, each reeved with 2,500 feet of 1½-inch, manilla rope, two pile drivers, eight hoisting engines, fourteen scows, three steamboats and one launch were required for the erection.

One of the most remarkable records of erection was made in building the Cairo bridge across the Mississippi. Here one of the great 518-foot double track spans, weighing 2,055,000 pounds, was erected and the falsework 104 feet high was removed in five days.

Ordinarily arch spans are erected in much the same manner as the ordinary straight spans. One across the Mississippi at Minneapolis was assembled on falsework with posts set in holes cut through the ice, and was remarkable for having the truss commenced at one end and assembled across to the other end instead of being assembled from both ends simultaneously and being finally connected up in the middle.

The Washington bridge, across the Harlem river, New York, has two 510-foot arches each with six deep plate girder ribs, which were assembled on falsework curved to fit the intrados, and having large openings in it to permit the passage of navigation and railroad trains. The girder sections were so large that they had to be shipped set in slots cut through the floors of flat cars. They were unloaded on a platform at skewback level, and distributed there by cars to derricks which traveled on top of the arch ribs from the ends of the span to the crown and lifted them and set them in place on the false work in advance of the assembled portions of the ribs. The derrick masts were adjustable on their platforms so as to remain vertical on the changing angles of the bridge. Most of the field splice rivets were driven by pneumatic yoke-machines, which were suspended from trolleys with grooved wheels rolling on round bars which in turn rolled on the horizontal struts of the spandrel bracing. The arch rib girders were set on double blocking on the false work caps between which hydraulic jacks were set and lifted the arch free to swing it.

The Rochester Driving Park bridge is a deck highway arch of 428 feet span and 212 feet high above the water. It was erected on false work built up level with the crown to form a platform for the traveler which was a small four-masted boom derrick. The false work was very heavily constructed, and contained a wide opening to pass the water of the Genessee river, which was spanned by a Howe truss bridge, seated on bracket corbels. The bridge was so near the Genessee Falls during the winter that the spray froze inches thick on the false work, rounding the timbers and making work extremely difficult and dangerous.

The Cincinnati Southern Railroad bridge has a channel span of 519 feet, which was famous as the longest truss span in America. It was notable for being built with the now generally obsolete upper false work, and the false work was twice washed out before the bridge was completed.

The Panther Hollow bridge, Pittsburg, Pa., is a deck highway arch with four three-hinge spandrel-braced trusses of 360 feet span. Each set of semi trusses from skewback to crown were built separately, one set being completed before the false work for the others was built. The trusses were swung as pin connected structures, and afterwards the joints at panel points were riveted with gusset plates with the idea the pin bearings would thus take all the dead load stresses and the riveted bearings would take live load stresses only.

A marvelous example of rapid bridge building and erection was in Cincinnati, in 1882, when in five weeks the material for the structure of a 550-foot double track railroad span was ordered and built, the false work and traveler constructed, and the span erected, swung and riveted up. The

false work was 85 feet high, and contained 5,000 50-foot piles driven in the treacherous Ohio river.

The railroad bridge across the St. John's river, New Brunswick, has a 477-foot span 96 feet above the water, and is a cantilever with unequal armed through trusses. It was one of the first steel cantilever bridges, and its construction by the Dominion Bridge Company was a daring and brilliant piece of engineering. The anchor arms were erected on shore false work, on which a 16 x 24-foot timber tower traveler 100 feet high moved. The channel arm and centre span were erected by a simple trussed derrick frame, which moved on temporary timbers fastened to the tops of the vertical posts and forming a steep incline on which it was necessary to anchor it securely. The men worked on suspended platforms, and all the hoisting was done with a single engine, which erected one-half the bridge, and was then transferred to the other shore to erect the other half.

The Lachine bridge, built several years later by the same company, was another courageous and admirable piece of work. Its two 408-foot channel spans, 60 feet above the swift water at the head of the famous rapids, were erected as balanced cantilevers from the narrow centre pier. The erection was commenced on brackets, built out from the pier top, and, as soon as enough of the truss was connected to receive them, travelers were put on top and simultaneously erected the opposite arms, great care being taken to work uniformly so as to keep the reactions equal, for if the equilibrium had become unstable, the result would have been disastrous.

The famous Eads bridge, across the Mississippi, at St. Louis, has three spans of 537 to 552 feet, which each have four-deck arch trusses, with their top and bottom chords made of built-up steel stave tubes. These trusses were erected as guyed cantilevers, backstays being carried from the extremity of the projecting truss to the top of a temporary oak tower on the pier above the skewback. This tower was seated on powerful hydraulic jacks, which were adjusted to raise or lower the ends of the semi-arch for final connection at the crown. Great difficulty was experienced in making these connections on account of the temperature expansions of the tubes and recourse was had to ice troughs which were placed around the tubes to contract them.

The great Forth bridge, with its unprecedented trussed cantilever spans, of 1,710 feet and towers 330 feet high, is remarkable for being made wholly with riveted connections, diametrically opposite to American practice, and for having its members built up out of plates riveted together in situ. The erection was very complicated and costly, and involved the use of much elaborate special plant. The towers were built up with great falsework girders, carried up on top of them as they rose, which were lifted by powerful hydraulic presses. The 12-foot steel tubes, which formed the principal truss members, were built out for long distances as cantilevers, supported only by their own stiffness, and were built in frameworks enclosing them and supporting the drilling and riveting machinery. As the tubes were extended, the rear bents of the framework were taken down and built out in front, and so on.

The Kasier Wilhelm bridge, across the Wupper, near Mungsten, Prussia, is a double track railroad deck structure with two parabolic arch truss spans of 525 feet in the clear, and is 350 feet high. The trusses were built out simultaneously from the skewbacks, and were supported partly as cantilevers by their own stiffness and partly by temporary guys to the tops of the great towers at skewback points. Material was delivered from a special low-level service bridge, and final adjustments were made by wedges at the crown and by hydraulic jacks at the skewbacks. It took nearly two years to build it, and it cost about four times as much as a similar structure in this country would. The Niagara railroad arch bridge is larger and heavier than the Kasier Wilhelm bridge, and was erected in six months, in rigid winter weather. It is a highway and double track railroad structure with two two-hinge, spandrel braced, arch trusses of 550-foot span, 310 feet above the water. The new bridge was built exactly on the centre of the famous old Suspension bridge, without interrupting the traffic on the former until the latter was ready to receive it. The new trusses formed a trough around the old structure and were erected by steel travelers moving on their horizontal top chords and astride of the old stiffening trusses and cables and clearing them. The trusses were built out simultaneously from the skewbacks and were anchored against downward revolution by temporary eye-bar chains attached to the ends of the top chords, and anchored in chambers quarried out of the solid rock. The centre erection adjustments were made by powerful screw toggles inserted in these chains with which the semi-spans were raised and lowered by sixteen men each.

The two-hinge highway bridge just below Niagara Falls has two trussed arch spans of 840 feet, the longest in the world, which were erected on the site of an old suspension bridge of 1,200 feet span. The erection method was somewhat similar to that for the Niagara railroad arch bridge, except that the curved top chords of the trusses were anchored by separate eyebar guys from the alternate panel points to the tops of the towers over the skewbacks, and the light travelers were supported on the roadway of the old Suspension bridge above. The bridge weighed over 3,650,000 pounds and was erected by 100 men in three months.

The 416-foot ordinary truss span of the Columbia river bridge was erected as a cantilever in a very difficult location, by the use of a 250-foot approach span. This was cut in two in the middle and each half erected, bottom side up, on false work at the ends of the main span and weighted with 400 tons of rails to serve as anchor arms for the cantilever erection reactions. Afterwards these trusses were taken down and re-erected to form the permanent span in the approach.

The famous Atbara bridge was a very simple, commonplace structure, with ordinary spans designed to act as cantilevers during erection only, and is interesting chiefly on accounts of its notoriety. In it there are seven light 150-foot through spans of ordinary pin connected single track railroad trusses. One span was temporarily erected on shore and served as an anchor arm from which the first span was erected as a cantilever. Then the anchor span was taken down and erected as a cantilever from the second span, and in its turn served as an anchor span for the erection of the succeeding span, and so on. The bridge was rolled, built and shipped in forty-two days after the contract was signed, and was erected in sixty working days by eight American bridge men and from 200 to 400 native soldiers and convicts.

The rebuilding of the Victoria bridge, at Montreal, was exceedingly interesting, on account of the magnitude and importance of the structure, and the great difficulties and ingenuity of replacing the old superstructure with a much larger new one, on the same piers without interfering with traffic. The old structure, 6,952 feet long, had twenty-four 254-foot spans and one centre span of 348 feet, all composed of iron tubes 16 feet wide, and from 18 to 22 feet deep. It was 60 feet above the water, weighed about 9,000 tons and cost about $7,000,000 (including the masonry). The new structure weighs about 21,000 tons, and has two lines of trusses about 31 feet apart on centres carrying two railroad tracks between them and two roadways outside. At each end of the bridge a steel traveling false work span was built which enclosed the old tube like an inverted trough, and was rolled along on top of it until its ends were supported on the masonry. The 65-foot plate girder floor beams for the permanent new span were suspended in their required positions and attached to the false work trusses. Then material tracks were laid on their extremities and the trusses were built upon them, connected and swung. The false work trusses were then moved out from between the old tube and the new span, advanced to the next pier, the operation repeated, and so on, simultaneously from both shores until both false work spans met at ends of 348-foot span when one of them was cut in two and one-half anchored over each of the middle piers so as to project 47 feet. The other span was then suspended from these arms and on it the permanent span was erected. Part of the chord pins were driven by special hydraulic rams, and after the new spans were completed, the old tube was cut to pieces and removed, the rivets being cut and backed out by special automatic pneumatic tools designed for the occasion.

A very ingenious and courageous bridge erection was successfully accomplished by the Dominion Bridge Co., in the construction of the Coteau bridge, across the St. Lawrence river, near the rapids of the same name. The bridge

includes ten 217-foot spans, and four 223-foot spans, and could not be erected advantageously at the site where the water was 30 feet deep, and had a velocity of seven miles an hour. False work was, therefore, built at about the required level on shore three miles above the bridge piers, and the spans successively erected on it, skidded off on towers on the decks of two barges braced together, and floated down stream between the piers and lowered to their seats there by partly sinking the boats. This was a very hazardous operation on account of the swift current, but it was successfully accomplished, although some trouble was had in controlling the barges and they once escaped and were turned around so as to reverse the position of the span. A much larger single span was erected in a similar way across the Ohio river, near Pittsburg, where, however the conditions were much less severe. There transverse rows of piles were driven in shallow water on the shore of an island about 300 feet from the axis of the bridge, and several lines of heavy longitudinal steel beams were set loosely on top of the pile caps. Ordinary framed trestle bents, nearly 100 feet high, were set on the beams in the planes of the pile bents, and the 525-foot double track span weighing 900 tons was erected on it. Nine coal barges were partly filled with water and placed between the pile bents and pumped out until their increasing bouyancy caused the pony bents on their decks to take bearing on the under sides of the steel beams, and finally lift them and the super-imposed span clear and free of the piles. Then the barges and their top heavy load, weighing in all 1,800 tons, were towed, clear of the piles, by several steamboats swung around 90 degrees, brought between the bridge piers and moored there. The barges were scuttled, and as the spans descended, steel bars thrust through the anchor bolt holes in the pedestals guided them to their required positions on the masonry seats.

Several spans of the Hawkesbury bridge in Australia were erected by American engineers in a similar manner. In this case, the false work was built on flat bottom boats, and the latter were sunk on a timber grillage in shallow water at a sheltered spot near the bridge site; both ends of the trusses overhung the falsework, cantileverwise, and the boats were pulled to place by fixed windlasses.

The same principle has frequently been used for the replacement of drawbridges, which have been floated under each arm, and bodily removed from the pivot pier while a previously erected new span was floated in, in a corresponding manner so as to cause little delay to traffic and practically no obstruction to navigation. One of the most recent instances of this was in replacing a double track draw span across the Passaic river, near Hoboken, N.J.

The Omaha bridge, across the Missouri river, carried two railroad tracks between the trusses and two highways cantilevered outside, and was replaced by a structure with new piers and superstructure on the same centre lines without interrupting train service. Temporary Howe truss deck spans were placed on the old and new piers and supported the tracks and the old trusses while being removed and the new spans while being erected. After a new span was completed and swung, the false work trusses were removed on boats and placed in position for the next span and so on.

The 236-foot double track span of the Pennsylvania Railroad main line, across the Schuylkill river, at Girard Ave., Philadelphia, was replaced without any interruption of the very frequent heavy express traffic, by the use of an auxiliary low level span alongside. This span consisted of four heavy steel trusses set on temporary pile tiers with its top chord below the bottom chord of the old and new spans, which were of the same depth. The new span was erected on this low level span and the track laid on its deck. Both old and new spans were lifted and set on large nests of solid steel rollers between long top and bottom rails. The track was cut and both spans were pulled transversely by tackles operated by hoisting engines on the opposite sides of the temporary piers until the new span completely displaced the old one and allowed a train to pass over it in 14 minutes after the last train had passed over the old span. In this manner a total weight of 1,400 tons was moved 27 feet in 2½ minutes. Afterwards, the false work span was moved to the opposite side of the bridge, underneath the new position of the old span and was used for taking down the old span.

It is customary abroad, especially with French engineers, to build viaducts, as continuous girders with stiff members, and erecting them successively on a horizontal platform at one end of the bridge, to launch them forward over rollers on top of the pier and abutment until the whole bridge is completed and gradually moved across to place. This method requires special design and involves the moving of an enormous mass in the final operations. An example is of the Birriz viaduct, in Costa Rica, where four single track 156-foot spans, 200 feet high, were pulled across the chasm by a wire rope operated by a windlass on the opposite abutment.

In the United States and Canada, viaducts and elevated railroads are usually erected by an overhead traveler moving on the finished structure and erecting it one bent in advance by an overhanging arm. A striking example was the Pecos viaduct, in Texas, which is 328 feet high with 35-foot towers, and 65-foot connecting spans, all of which were erected, as well as a longer cantilever span in the middle, by a heavily counterweighted traveler whose trusses were mounted on a steel tower and overhung it 124 feet. It had a 57-foot wheelbase, was clamped to the track, and handled 65-foot girders weighing 22,000 pounds It erected the tallest tower, which was 35 x 100 feet at the base, in six days.

The Gokteik viaduct, Burmah, Asia, was recently built and erected by an American firm, who used the longest overhanging trusses for the erecting traveler that have ever been built. The viaduct is 2,260 feet long and 320 feet high, and weighs 3,500,000 pounds. It is designed for a double track railroad, but now has only one track with a solid steel plate floor enabling it to be used for highway traffic The towers are 40 feet wide, and are connected by 129-foot lattice girder spans. The erecting traveler was 219 feet long with a 165-foot cantilever, and was made of steel and weighed 180,000 pounds. After the viaduct was erected, the traveler was sold on the spot for scrap. All engines, tools, ropes and other equipment was taken from America and the erection was accomplished in nine months by a force of 35 American bridge men and about 500 native mechanics, sailors and laborers.

The Charlestown bridge, Boston, Mass., has a 240-foot draw span 100 feet wide with very heavy trusses and floor system, which was erected by the usual striding traveler on pile false work, but was remarkable because the traveler moved on top of the fender pier, outside the false work which was thus relieved of considerable weight.

The Braddock bridge, across the Monogahela river, near Pittsburg, is a highway structure with unusually long spans, one of them being about 460 feet. It was erected on ordinary pile false work, which under the channel span had a wide trussed opening for navigation. The traveler was a tall, light timber tower with three bents.

Sometimes a deck bridge is erected by an overhead traveler, which may be only a moveable derrick or combination of derricks which travels on the top chords. An example of this method of construction is the railroad bridge at Woonsocket, R.I., where the heavy truss members were erected by two booms on the forward corners of a wooden tower, which rolled on the top chords and set one panel of the trusses and floor system in advance on the false work, and then moved on to it. The material was delivered on the permanent track, as it was completed on the structure, and the bottom of the traveler was kept clear of transverse struts to leave a free track through it, working platforms for the men and to support engines, tools, etc., being suspended on each side from the top.

ELECTRIC POWER TO TORONTO.

The Niagara Falls Power Co. (the Rankine syndicate), announces that it will now proceed with the power development on the Canadian side, under the charter of the Canadian Niagara Power Co., and that a contract has been let to A. C. Douglass, of Niagara Falls, N.Y. The plan is to develop 25,000 h.p., of which about 10,000 h.p. will be conveyed to Toronto; some will be applied to local use, and about a third will be held for use on the United States side. The intake

canal will be cut from the head of Cedar Island, and run to the power house site within the park. The tunnel by which the water will be discharged down into the Niagara below the falls will have a capacity for the development of 100,000 horse power. The machinery used will be of much the same type as that on the American side, and cables will be used across the river so that an interchange of current can be made in case of accident or the fluctuation in demand on either side. The outlay required for this development is $1,500,000.

W. M. German, M.P.P., for Welland, who is connected with the Ontario Niagara Power Co., a Canadian concern, which has an agreement with the Ontario Government till May, 1902, to develop power there, says his company will also soon start operations, and will not forfeit their charter.

METAL TRADE OF GREAT BRITAIN WITH CANADA.

The following are the sterling values of exports of metals, etc., from Great Britain to Canada for March, and the three months ending March of 1900 and 1901:

	Month of March.		Three months ending March.	
	1900.	1901.	1900.	1901.
	£	£	£	£
Cutlery	5,602	4,352	12,923	10,035
Hardware	3,153	1,850	7,516	5,631
Pig iron	1,097	....	8,777	1,157
Bar, etc	2,201	169	4,738	1,196
Railroad	....	....	320	....
Hoops and sheets	2,288	786	5,924	2,199
Galvanized sheets	3,626	2,682	11,105	5,562
Tin plates	15,875	13,638	60,622	33,781
Cast, wrought, etc., iron	3,861	3,215	13,050	7,130
Old (for remanufacture)	909	.....	7,083	.....
Steel	26,751	5,000	72,701	11,546
Lead	3,390	2,563	5,108	5,114
Tin (unwrought)	2,201	1,699	9,157	4,368
Alkali	2,686	....	7,225	....
Cement	3,128	1,522	3,708	2,436

Among the imports of Great Britain from Canada, wood pulp to the value of £58,586 for the first quarter of 1901 shows an enormous increase on the same months of 1900, when the value was £15,275.

AMERICAN STEAM GAUGE AND VALVE MNFG. CO.

We have to thank the American Steam Gauge and Valve Mnfg. Co. (successors to the American Steam Gauge Co.), of Boston, for an invitation to the celebration of the 50th anniversary of their organization. The jubilee of this company is an event which enables them to bring in review a record of great progress, not only in the scope of the business, but in the methods of manufacturing for which our American neighbors have become famous. When, in March, 1851, the company was organized, the business consisted exclusively of the manufacture of steam gauges with Bourdon springs under the United States rights of the patent of M. Bourdon of Paris, this company being the original, and for many years thereafter the only manufacturers of these gauges in the United States. "From time to time," says a circular issued by the company, "new and meritorious specialties have been added to the product until to day the output of this company is unsurpassed by any manufacturer in the world." Among the most noted specialties manufactured by this company in addition to its well known line of gauges for all purposes is the Thompson improved indicator, which is recognized as the standard indicator throughout the world. It has been adopted by the United States and foreign navies, by all the principal universities and technical institutes, as well as by the leading engineers and engine builders, and as a further proof of its merit, received the highest award at the Paris Exposition, and was the only American indicator to receive a medal. Another, and one of the largest lines now manufactured by this company, is the American patent pop safety valves. This line embraces the American, Board of Trade, Navy and United States Marine patent of Marine Pop Safety Valves. Also, American, special inspectors', and compound lever patent stationary valves. Also, yacht, portable, farm engine, fire engine, locomotive (plain and muffled), steam heating, house heating, cylinder relief and water relief, and the celebrated underwriter pattern of water relief valves. In addition to the above leading specialties, this company manufactures a full line of standard appliances for measuring, recording, indicating and controlling steam, air, gas, ammonia and other pressures."

ANSWERS TO CORRESPONDENTS.

Two subscribers ask how they are to obtain a certificate of qualification as stationary engineer in Ontario. In this province there is an examining board authorized to grant certificates, known as the Ontario Association of Stationary Engineers. All particulars may be obtained from A. E. Edkins, the registrar of this body. His address is care Boiler Inspection and Insurance Co., Canada Life Building, Toronto.

ENQUIRER.—Porous silicious earths of organic origin, known as infusorial earths are found both in the United States and Canada. There are some very promising beds in New Brunswick and Nova Scotia, and some of the best qualities of polishing preparations in use on this continent are made from earths dug in the Maritime provinces. Infusorial earths are the shells or bodies of microscopic organisms found in the bottoms of certain small lakes, and the material is made into polishing powders and soaps for metals. It also makes an absorbent for dynamite made from nitro-glycerine, and owing to its non-conductivity to heat infusorial earth makes a good packing for steam pipes, safes, etc. Its value at some points of shipment is about $7 or $8 a ton.

L. A. BEAUCHEMIN, Chatillon, Que., asks: What would be the best mode of foundation for a building of 35 feet height, 4 feet thick stone wall, and 100 by 60 outside measure; the ground is a soft blue clay under a couple of feet of harder stuff, but not strong enough to hold the building, for it has sunk so much as to be unsafe. There is about 100 feet of clay. How long and far apart should the piles be driven, if such are recommended? Will the piles be subject to rot? Messrs. Bond & Smith, architects, Toronto, advise as follows: Stagger the piles about two feet apart. Drive them down as far as they can be driven, until a 2,500 pound drop weight in the pile driving machine will not force the pile down more than half an inch at a blow. Piles under water will last much longer than if the heads are left exposed to the air above water.

THE BEET SUGAR INDUSTRY.

The beet root sugar industry is a prominent and practical question with our farmers at this moment, and the Ontario Department of Agriculture has already completed arrangements for testing localities to find suitable soil for its growth. The seed is already distributed, and farmers, some 40 or 50 in number, will under the supervision of Prof. Shuttleworth, commence immediate operations. Twelve localities will be tested as follows: Waterford and Simcoe; Whitby and Lindsay; London and Alvinston; Mount Forest and Walkerton; Peterboro and Prince Edward; Dunnville and Cayuga. A syndicate from Scranton, Pa., contemplates the erection of two beet sugar factories, one in Eastern and the other in Western Ontario. Brockville, through Mayor Buell, is seeking to have one of the two erected there. The village of Wallaceburg expects to have the first factory. In view of the interest attracted by the subject, the recent open letter issued by John Waddell, D.Sc., lecturer on Industrial Chemistry, Kingston School of Mining, containing valuable information on the subject, entitles him to the thanks of the farming community for his alertness in bringing his practical knowledge to the front for the benefit of those chiefly concerned. The right seed this year, at least, may be taken for granted, but Mr. Waddell points out that equally important is suitable soil and careful cultivation. The best soil is sandy loam, or a warm and moist clay loam, with a sub-soil of the same character. It needs to be well ploughed and subsoiled in the fall, especially after a dry summer. Spring harrowing cannot be too frequent for a good crop, finishing with a roller. The seed should be shallow-drilled about 18 inches

apart, 15 lbs. of seed to the acre. The young plants must be thinned and weeds kept down; fertilizers sparingly used, barnyard manure especially being avoided the same year in which the beets are grown. The following is a good rotation of crops: 1. Hay; 2. winter wheat, potatoes or fodder corn; 3. sugar beets; 4. spring wheat, barley or oats seeded. The tops of the beets, containing rich potash and phosphoric acid, form valuable manure.

—If more of our civil engineers had the backbone of Wm. T. Jennings, C.E., Toronto, it would be better for the dignity of the profession. Mr. Jennings was recently engaged to report on a sewage system for Oshawa, Ont., and when his report was discussed in the town council one of the councillors declared that "Jennings had got his report from some young fellow working in the city," and further stated, "it is plain that this man (meaning Mr. Jennings), was paid to report favorably on both systems," hinting that he had received pay from private individuals as well as the town. Mr. Jennings promptly instructed John Jennings, solicitor of Toronto, to take steps to compel the councillor to prove his statements. This brought the councillor to a realizing sense of the recklessness of his criticisms, and he not only had to confess that his statements were absolutely without foundation, but that he had not even a rumor on which to base his insinuations. The slanderer, who was a well-known local manufacturer, had the humiliation of being compelled to make a full retraction of his irresponsible statements in writing, to be read at the succeeding meeting of the council, and to be published in the local papers.

Industrial Notes.

The first steel bridge over the Klondike river was opened April 10.

The contract for the new hotel in King street, Toronto, to cost nearly $800,000, has been secured by Illsley & Horn.

The new pulp mills at Cowie's mills, N.S., are now in operation. There are now three pulp mills in Queen's county.

The Smart-Eby Machine Co. have installed one of their duplex pumps, with shafting, etc., for C. A. Matheson's new peat works at Perth, Ont.

All the iron moulders in the employ of McLean & Holt and the St. John Iron Works, and Allan Bros., in Carleton, N.B., are out on strike, asking for an increase of 25c. per day.

The new addition to the factory of the Metal Shingle & Siding Co., of Preston, Ont., recently alluded to, is 48 by 50 feet, two storeys high. The company's business has grown rapidly since it started.

The Stevens Arms and Tool Co., of Chicopee Falls, Mass., have arranged with H. M. Pope to make his celebrated rifle barrels. The new barrel will be known as the Stevens-Pope, and will be made to fit any standard action.

McOuat & McRae, Lachute Mills, Que., have just installed two of their 3-pocket pulp grinders to the Chatham, N.B., pulp mills. The new machines are doing all that is claimed for them. The firm are running overtime and require more hands.

The work of erecting the steel superstructure of the new bridge over the ravine at St. Thomas, Ont., for the L. E. & D.R.R. will soon be under way. James Hill, engineer of the Canadian Bridge Company, Walkerville, has charge of the erection.

J. Robinson, of Toronto, who represents a syndicate of Toronto and London (Ontario) capitalists, has written to the Mayor of Ottawa, asking what inducements that city would hold out for the establishment of smelting and structural iron works in that city.

The American Bridge Company has been awarded a contract by the Quebec and Lake St. John Railway for the construction of a bridge at St. Catherines to cross the Jacques Cartier River. The plans are for a bridge 450 feet in length and 60 feet above the river.

Drayton, Ont., has voted a loan of $10,000 for a felt shoe factory.

Iroquois, Ont., has passed a bylaw to purchase and extend the waterworks system of the town.

The new Canadian mint, for which $75,000 per year has been appropriated, will be located at Ottawa, it is thought.

F. W. Hore's Sons have recently purchased a number of extra bending machines from the Smart-Eby Machine Co., Hamilton.

The O'Keefe Brewery Company are enlarging their premises, corner of Gould and Victoria streets, Toronto, at a cost of nearly $20,000.

The Smart-Eby Machine Co. have recently installed a unique machine in the Upton canning factory for slicing oranges for marmalade.

The D. F. Brown Paper Box and Paper Company have ordered from the Robb Engineering Company, a 70-h.p. Mumford standard boiler for the new factory they are building at St. John, N.B.

The Commissioner of Public Works of New Brunswick is calling for tenders for the substructure of the proposed bridge over the St. John river near Andover. The tenders will be received up to June 17th.

The financial difficulties of Copp Bros., stove founders, of Hamilton, were learned of with general regret. The firm was an old and honorable one and employed 120 hands. A settlement has been made, and the business continued.

Thomas Davidson, of the Thos. Davidson Mnfg. Co., Montreal, is considering the erection of works near Montreal for the production of steel ingots, having inspected similar works in the United States.

The Smart-Eby Machine Co. have installed a set of Rogers' patent shaking and dumping grate bars in Malcolm & Souter's new factory.

The bridge at Richmond, Que., swept away by the recent floods will not be rebuilt till summer, and meantime a ferry service has been started. A new ferry-boat is being put on, to be run by electricity, a trolley being used.

The Robb Engineering Co. are building for the Dominion Iron & Steel Co., a 100-h.p. engine, and two 100-h.p. boilers for their works in Cape Breton, also four 60-h.p. boilers for their iron mine at Bell Island, Newfoundland.

The Ontario Powder Company is being incorporated to take over the business of manufacturing explosives carried on by Daniel Smith and Colin Angus Macpherson, of Kingston, under the name of the Ontario Powder Works. The proposed capital is $100,000.

A. M. Bell, of Halifax; J. W. Lowe, of Aylesford, N.S.; Charles Pickard, of Sackville, N.B.; F. P. Thompson, of Fredericton, and P. J. Mooney, of St. John, are forming the Sackville Free Stone Co., to carry on a stone quarrying business at Sackville with a capital of $24,000.

A company with $25,000 capital stock is being formed in Hespeler to erect a 100 by 80 3-storey brick furniture factory. Mr. Greutzner, late manager of the Simpson Company's factory of Berlin, is one of the promoters. The concern will be known as the Hespeler Furniture Company.

F. L. Smidth & Co., 66 Maiden Lane, New York city, engineers and builders of cement manufacturing machinery, have received the contract for equipping the plant of the Iroquois Portland Cement Company, now being built at Caledonia, New York, with Davidson patent tube mills.

The name of the new English company who succeed to the foundry works of Armstrong & Morrison, Vancouver, is the Vancouver Engineering Works, Ltd. Geo. A. Walkem, of Kingston, has been appointed manager. Mr. Walkem is a graduate of McGill, having had the degree of B.Sc. in 1895.

The recent purchase of Nova Scotia lumber property by W. D. Beardmore, Toronto, Henry Patton, Albany, N.Y., and H. R. Wells, Canton, N.Y., is regarded as an important transaction. The property consists of 75,000 acres of timber land near St. Margaret's Bay, for which $250,000 was paid, and the new company will build new saw mills and tanneries in addition to the mills already there.

The Toronto Lithographing Co. have started the erection of a large new building on King street, near Spadina avenue, for their lithographic works. The company's present premises, Bathurst street, have been purchased by the Newell & Higel Co., who will extend their organ and piano action works.

The Robb Engineering Company has purchased five acres of land adjoining their present property, and during the summer will erect additions to their buildings. The moulding shop extension is already under construction, and work will be commenced on the boiler shop and machine shop in a short time.

Crane Co., the extensive manufacturers of valves, fittings, etc., Chicago, have decided to erect this summer a modern fire-proof building, exclusively for offices. It will be about 90 feet by 100 feet, five stories and basement, and will be located in the vicinity of its large cast-iron and malleable fitting and valve works, at Canal and 12th streets.

The Good Roads Machinery Co., manufacturers of road machinery and appliances, has been turned into a joint-stock company, with a total capital stock of $40,000; headquarters at the city of Hamilton, Ont. John Challen, who has energetically worked the business up to its present position, is president of the new company.

A report comes from Philadelphia that the new steel company, to include English and Canadian interests, which has been hinted at for some months, is organizing under the name of the International Steel Iron & Pipe Co., with a capital of $50,000,000. It is proposed to build big steel mills on both sides of the "Soo" canal. A. R. Harvey, the English promoter, is said to be interested.

The American School of Correspondence, Boston, situated at a recognized industrial and educational centre, has among its instructors men who are regular teachers in several of the great technical schools of Boston, and has unusual advantages for teaching the theory of trades and engineering professions. Their free scholarship offer for engineering and mechanical drawing is a feature which should attract attention.

R. Chestnut & Sons, founders, Fredericton, N.B., have instituted the co-operative or profit-sharing system at their works. The plan is as follows: The proprietors will take a stated percentage as interest on the capital invested. At the end of the year whatever profits remain over and above the small percentage which goes to the proprietors, will be divided among the proprietors and workmen, the proprietors taking one-half and the remaining amount being divided among the men pro rata, according to the wages which they receive.

The Smooth-On Mnfg. Co., Jersey City, N.J., have placed on the market an iron cement, in powdered form, for repairing leaks or fractures in steam or hydraulic work. It is applied by mixing with water, has the same color and appearance as cast iron, hardens quickly, and expands in hardening. When hard it will withstand a red heat, steam, water or oil, and expands and contracts the same as iron, ensuring a tight joint at all temperatures. Difficult flanged connections can easily be made with Smooth-On compound, as it adapts itself to the flanged faces whether parallel or not. A catalogue and prices will be sent on application.

A second bridge across the St. Lawrence at Montreal is proposed, the promoters being connected with the Rutland and New York Central railways. The old charter of the Montreal Bridge Co. has been secured and the company reorganized with the following officers: President, Henry Hogan; vice-president, Percival Clement, president of the Rutland Railway; directors, Dr. W. S. Webb, president of the St. Lawrence & Adirondack Railway, Hiram Steele, director of the New York Central, Hon. J. R. Thibaudeau, Hon. T. Berthiaume, R. Bickerdike, M.P., and R. Prefontaine, M.P. The estimated cost of the bridge is $6,000,000.

The B. F. Sturtevant Co., of Boston, Mass., is rapidly recovering from the effects of the fire of April 13th, which affected only the engine and electrical departments. With only a day's delay incident to the renewal of belts the remainder of the plant has been running as usual. Already a complete new equipment of improved machine tools is nearly installed in other buildings. As the Sturtevant Co. employs electric transmission for the driving of a considerable portion of its tools this work of installation has been a comparatively simple matter. Further delay in shipment of engine and electrical work is unlikely, for no patterns or drawings were destroyed, and the foundry with a large stock of castings is intact.

The Dodge Manufacturing Co., of Toronto, say they find their iron centre wood rim split pulley in strong demand of late. Their trade in this line has taken wonderful strides, especially in pulleys of large diameters, recent orders, including one pulley 18-feet diameter by 38-inch face; one 13-feet diameter by 28-inch face; one 12-feet diameter by 28-inch face; three 10-feet diameter by 38-inch face, and two car-loads of various sizes for Canadian Portland Cement Works at Marlbank. The special claim for this pulley is, that while it provides all the positiveness of its iron hub and arms for keying and set screws to shaft, the better belt surface of the wood rim, and its safety for high rim speeds, it is light in weight, and the saving in first cost is important. Many prominent engineers are recognizing these features in this pulley.

A. J. Moxham, general manager of the Dominion Iron & Steel Co., during his recent speech before the Canadian Manufacturers' Association, made the following remarks: "As an instance of the development which might be expected in Canada," he stated, "that the company are building five very large blowing machines. No bigger machines of the sort exist in the world; some of equal size are in use in the United States. The United States manufacturers proved rather slow, and in a moment of wisdom, or of folly—he did not yet know which—he got permission to have them built in Canada. It was being done at the moment, and he thought they were doing it successfully. It was the prelude to more business which would come naturally, and things like that would put into the minds of their foundrymen and machinists the conviction that they could do the big things that other people did." The machines referred to were manufactured at the works of the Laurie Engine Co., Montreal. The two largest pieces are cylinders, 9-feet in diameter, and weighing 30 to 35 tons, together with several large castings weighing 20 to 25 tons.

Electric Flashes.

Parry Sound has adopted the by-law to purchase the electric light plant at $27,000.

A by-law to install a system of water-works and take over the electric light plant at Midland, Ont., has been adopted.

The Belleville city council has accepted the tender of the Trenton, Ont., Electric Co., to supply the city with lighting.

The Toronto Railway Co. will this summer install a new 1,000-h.p. generator, and will put on 80 new cars during the year.

The Jones & Moore Electric Co. are installing a complete new lighting plant, including search light, on the steamer "Persia."

The Light Commissioners of Brockville are asking the citizens for $25,000 to renew and extend the gas plant, and a bylaw will be submitted.

Frederick Thompson, of Montreal, has been appointed electrical expert for Kingston to value the plant which the city will purchase after arbitration.

The Can. Gen. Elec. Co. has secured the contract for the electric machinery required by the Ontario Power Co. The complete plant is to be installed within two years from date.

The Peterborough Navigation Co. are installing a direct connected electric light plant and search-light on one of their steamers. The order has been placed with the Jones & Moore Electric Co., of Toronto.

The National Electric Light Association of the United States will hold its next convention at Niagara Falls, on the 21st, 22nd and 23rd May. A good programme has been provided, and a good number of Canadians are expected to attend. The headquarters will be at the International Hotel. The secretary is Geo. F. Porter, 136 Liberty street, New York city.

S R. Hughes & Co., contractors, Toronto, have placed an order with the Jones & Moore Electric Co. for a 25-h.p. electric motor to operate their wood-working machinery.

The electric plant of the West Kootenay Power & Light Company, at Bonnington Falls, is to be greatly extended, a contract having been let for the machinery necessary to enlarge the plant to 12,000-h.p.

Sydney, C.B., is going to have an electric street railway. At a meeting of the Cape Breton Electric Company, held April 17th, sufficient capital was subscribed to ensure the building of the road within a year.

The Cornwall Electric Street Railway Co. have purchased the property of the Cornwall Milling Co., and are fitting it up as a power house for operating their line. It is expected that the turbines will be turned on about July 1st.

The Royal Electric Co.'s contract for lighting Montreal expires December, 1903, and tenders are now being called for on a new contract. Specifications are now out and tenders are to be in by June 15th. Tenderers must accompany bids by an accepted cheque for $50,000.

The Bell Telephone Company's application for authority to increase the capital stock to $10,000,000, though vigorously opposed by the city of Toronto and many other municipalities of Canada, has passed the Senate committee, and the safeguard as to rates, provided in the act of 1892, has been dropped.

W. R. Russell, manager of the Q.R., L. & P. Company, says of the company's road from Quebec to Ste. Anne: Our line of railway is only 30 miles in length, yet last year we carried over half a million passengers. The indications for the approaching season are that the traffic will far exceed this amount. A speed of 46 miles an hour is frequent on this line.

The Jones & Moore Electric Co. have received duplicate orders from the City Dairy Co., the Bryant Press Co. and Toronto World for electric motors. Among the firm's new customers for motors are: A. E. Fryers, C. Constable, Cameron Mnfg. Co., Bradshaw & Co., R. Donlan and Wampole & Co.

The arrangements for the annual meeting of the Canadian Electrical Association at Ottawa, June 19th to 21st, are progressing. All the electrical companies of Ottawa are represented on the local entertainment committee. All information can be had from the secretary, C. H. Mortimer, Confederation Life Building, Toronto.

Electric power generated on the Yuba River, Cal., was last month successfully transmitted to San Francisco, a distance of 140 miles. The cable, 140 miles in length, is six-tenths of an inch in diameter, and is of copper, with aluminum alloy to prevent oxidization. An alternating current of 40,000 volts was transmitted with a loss, said not to exceed 5 per cent. Power is to be transmitted over the same company's lines to San Jose, 190 miles from the generating plant.

The Maitland River Power Company has been formed for the purpose of developing and selling to factories the water power of Maitland River, and the council of Goderich, Ont., granted them the franchise of supplying power for the water works and electric light. The company will expend about $100,000 this season in building dams at various points, having acquired river rights for several miles. James Clark and J. A. McIntosh are the promoters of the company and chief stockholders.

The Montreal Gas Co., the Royal Electric Co. and the Chambly Manufacturing Co., of Montreal, are amalgamating, under the name of the Montreal Light, Heat & Power Co., which will have a capital of $17,000,000. At a meeting held on April 4th the new company was formed, and the following were elected as the Board of Directors: President, H. S. Holt; 1st vice-president, J. Ross; 2nd vice-president, R. Forget. Directors, Hon. L. J. Forget, Hon. H. B. Rainville, Hon. R. Mackay, C. E. L. Porteous, F. C. Henshaw, and H. M. Allan. H. H. Henshaw was appointed secretary.

The Packard Electric Co., of St. Catharines, have issued the following announcement: "Owing to ill-health, E. E. Cary, has resigned his position as manager of this company, which position has been accepted by R. B. Hamilton, who, during Mr. Cary's illness of the past two months has been acting manager. Mr. Hamilton's technical education and practical experience are a guarantee that the excellence of the Packard product will be fully maintained and advanced, and important improvements have already been inaugurated, with most satisfying results. Geo. A. Powell, who has been absent for the past four months, has returned, and will assume the management of the sales department."

Railway Matters.

A. E. Geiger, passenger agent of the Brockville, Westport & Sault Ste. Marie Railway, has been appointed superintendent of the road in place of James Mooney, who resigned owing to ill-health.

The Midland Railway Company of Nova Scotia expects the line to be open next month from Windsor, N.S., to Truro, crossing the Shubenacadie river. The Dominion Bridge Company is building the bridge across the river.

Robt. McCallum, Ontario Government engineer, reports that rails are laid on the Ontario and Rainy River Railway to 140 miles west from Port Arthur, and construction trains running. The line is to be completed to the mouth of the Rainy River by the end of the summer. Several iron mines are being developed along the route.

The bridge for the Chateauguay & Northern Ry. over the Ottawa, near its confluence with the St. Lawrence, is to be started in a few days, and the line from Montreal to Joliette will also soon be commenced. The bridge will be 4,708 feet long. It will be in two sections, one of 11 spans and the other of 8 spans. It will be a single track bridge with a roadway for carriages on each side.

The Nova Scotia Government is aiding the construction of a railway from Halifax to Yarmouth by the South Shore route, a distance of 170 miles. The Government will lend the company $10,000 instead of giving a cash subsidy. Part of this road is already in operation from Yarmouth to Barrington. The Government will control the freight and passenger rates and reserve the right to take over the road.

The terms of the Ontario Government's concession to the Manitoulin & North Shore Ry. Co., one of the Clergue syndicate's enterprises, are mainly as follows: In return for a grant by the Province of 2,512,000 acres of land, and no cash, the company undertakes to build a railway commencing at Meaford, running through Owen Sound, Wiarton and the Bruce Peninsula, thence by car ferry to Manitoulin Island. Crossing the island railway will run northerly for some distance, sending a spur to Sudbury and then head west for 105 miles. The company grants running privileges to any other railway and the Government retains control of the right of way and of rates. The company will erect a 300-ton public smelter in the Sudbury mining region, and will locate 1,000 settlers per year for ten years on its lands. The timber and minerals are to be manufactured in Canada.

Personal.

John Carruthers, president and manager of the Prescott Emery Wheel Company, died on April 1st.

Milton L. Hersey, M.Sc., of McGill, has been appointed analyst for the Dominion Government at Montreal.

McGill University has conferred the degree of Doctor of Science on Dr. Robt. Bell of the Geological Survey, Ottawa.

W. J. Carroll, of St. Catharines, has been appointed chief engineer of construction on the Van Horne system of railways in Cuba.

A. E. Ozoui has been appointed mechanical superintendent of the works of Wm. R. Perrin & Co., Toronto, in succession to J. F. Lawson.

Ralph Demo, superintendent of the Bristol railroad, was recently elected general manager, secretary and treasurer of the Sherbrooke, Que., Railway Co.

Hiram Donkin, resident manager of the Dominion Coal Company, has resigned, and is to be succeeded by Christopher Shields, at present general manager of the Virginia Coal and Iron Company.

Harry Rolfe, of the International Correspondence Schools, Scranton, Pa., has accepted an important position in the mechanical engineering department of the Westinghouse Electric and Mnfg. Co., Pittsburg, Pa.

Richard Pennefather Rothwell died at his home in New York on April 18. He was a mining engineer and journalist of distinction, being editor for years of the Engineering and Mining Journal, and compiler of the valuable mineral statistics published by that journal. He was born at Ingersoll, Ont., in 1837.

Jabel Robinson, jr., C.E., son of the member for West Elgin, and a graduate of the School of Science, has been appointed District Engineer at Macleod for the Government of the Northwest Territories. C. Carroll, C.E., has been appointed engineer and surveyor for the same government for the district of Saskatchewan.

J. E. Dalrymple, the new assistant general manager of the Grand Trunk Railway, has been connected with the Grand Trunk Railway system since 1883, having served in the treasurer's office of that company, in Montreal, from July 1, 1883, until April, 1890. April 1st, 1890 he became connected with the Chicago and Grand Trunk Railway, as secretary to the traffic manager of that company. In February, 1896, he returned to Montreal, as secretary to the general traffic manager, Grand Trunk Railway system. May 1st, 1899, he was appointed division freight agent at Hamilton. August 1st, 1899, was appointed division freight agent at Detroit, and also manager of the Grand Trunk Despatch, which is a fast freight line operating over the Grand Trunk Railway system, West Shore and Fitchburgh railroads. May 1st, 1900, he was appointed general freight agent of the Central Vermont Railway at St. Albans, Vt.

Mining Matters.

A 10-stamp mill is to be erected at the Independence mine in the Manitou district.

A new gas well has been struck at Leamington, Ont., which yields about 1,500,000 feet per 24 hours.

A seam of good quality anthracite coal has been struck near Souris, Man., by J. Thompson, contractor, acting for the Anthracite Coal Co.

An Order-in Council has been passed reducing the royalty charge on gold recovered in the Yukon Territory from 10 to 5 per cent.

The iron and steel bounties paid last year in Canada amounted to $312,777, being an increase of $32,068 over the previous year.

The Government well boring machine struck natural gas at the roller mills at Mehta, Man., while boring for water. The gas was struck at 160 feet.

Charles Fergie, consulting engineer for Mackenzie, Mann & Co., has ordered an engine from the Robb Engineering Co., for the mines at Broad Cove, C.B.

A $1,000,000 company has been formed by American capitalists called the Honor Bright Gold Mine Company of Ontario, Ltd. Head office at Berlin, Waterloo county.

Justice Lount has granted an order to wind up the Trill Mining and Manufacturing Company of Ontario. The petitioner was Joseph Wharton, of Philadelphia, a creditor for $14,000.

A rich second bed rock has been discovered on the famous Eldorado creek of the Klondike. Pans have yielded as high as $50, and in one day two men took out dirt that contained $5,000.

A rich deposit of iron has been discovered near Fraserville, on the Temiscouata railway. Specimens have been submitted for examination, and the iron is declared to be compact hematite of very good quality, containing 60 per cent. of iron.

The municipality of Guysboro, C.B., have recently granted a free right-of-way to the Dominion Iron and Steel Co., of Sydney for a tramway or railway from the iron mines at Salmon River to a point at or near the town of Guysboro.

Wiley Bros., of Port Arthur, owners of the West End Silver Mine, have just made one of the richest strikes in silver ever made in a mine in this part of the country. A shot was put in that produced a vein of almost solid silver and running through the whole length of the mine.

A second smelter is now practically assured to Grand Forks, B.C. C. R. Tuttle, manager of the American Mining Investment Company, of Minneapolis, together with some Duluth capitalists, proposes building a 1,000-ton smelter, if a site can be obtained, and contracts secured.

The Ontario Government has decided to prohibit the exportation of gas from the Essex fields to Detroit. The Interior Construction & Improvement Co. will be notified that their lease of occupation of the bed of the Detroit River will be cancelled when the time expires.

The Le Roi, War Eagle and Centre Star contemplate bringing in water from near Sheep Lake, and the erection of one or two very large concentrators. The operation of this plant would double the output of the camp. It is claimed it will be put in operation this summer.

The laboratory report of the Ontario Government Assay office at Belleville directs the attention of prospectors to the probable existence of monazite in river beds and lake shores of Ontario. As its commercial value is $110 per ton, and the sole supply at present comes from North Carolina, prospectors will do well to take note.

J. McEvoy, of the Geological Survey, has made a report to the Government on the Crow's Nest coal fields, which he estimates to contain over 22,000,000,000 tons of possibly workable coal. Putting the price at only $2 a ton, the value of these fields would be $44,000,000,000. At Fernie, the output is considerably over 1,000 tons a day, of which about half is converted into coke, there being 360 bee-hive ovens in constant operation.

An important deputation from the British Columbia miners waited on the Premier on April 15. Owing to the decision of the American smelter owners to take no more ore from Canada, it had become impossible to have the ore refined as the two Canadian smelters, one at the Hall Mines and the other the C.P.R. smelter at Trail could only take a small tithe of ore now stacked. The Government was asked to subsidize a new smelter which might be erected at Lake Erie or Montreal. The Premier said Mr. Fielding would give his attention to the question.

A. P. Low, late of the Geological Survey, is going to Labrador for a Philadelphia syndicate. He is one of the few men who have any scientific knowledge of the great mountains of iron ore to be found in Labrador, and is paid $10,000 a year, and three per cent. interest in the stock, to secure his exclusive services. He will be accompanied by M. W. Hopkins, C.E., of Hamilton, and will be away for nearly two years.

The British Columbia mines have this year been chosen as the objective point of the McGill University Summer Mining Class. The students, about 20 in number, under the care of Dr. J. B. Porter, professor of mining, and Dr. F. D. Adams, professor of geology, left on May 1. They will visit the principal western mines, taking full notes en route of a practical character, which will be utilized on return to furnish a permanent record of the expedition.

The Nickel Copper Company, of Hamilton, have bought the McConnell properties in the northern Sudbury district at a price said to reach $300,000. At a meeting of the shareholders it was also decided to purchase the Canadian patents of the Frasch process of refining nickel and copper. Prof. Frasch, who was added to the board of directors, is said to have received $25,000 in cash, as well as $25,000 worth of stock in the company. These reports of prices should be taken with reserve.

Robt. Jaffray, who went to British Columbia in the interests of the Crow's Nest Pass Coal Co., has returned to Toronto. He expects the charter for the new railway to be granted soon. The line will run to the boundary and meet there the Great Northern branch shortly to be built. Mr. Jaffray in an interview to The Globe, says the smelter interest is being developed, and attracting the attention of capitalists from the States, who are awaiting the railway charter before taking definite steps. There is a strong feeling in British Columbia for an open door for railways, without which the mineral wealth of the province cannot be fully developed. Immense bodies of low grade ore exist, and to treat them satisfactorily, economical working and low rates, resulting from competition are necessary. The supply of coal at Crow's Nest Pass and the coke ovens at Fernie we have alluded to elsewhere, but Mr. Jaffray expects the coke ovens will number fully 1,000 before the railway is completed. The output of coal in the Pass is now about 1,700 tons per day, and with further facilities and consequent developments will undoubtedly reach a daily output of 10,000 tons.

Marine News.

A plebiscite to grant a bonus of $200,000 for the establishment of a steel shipbuilding plant was carried at Halifax by ten to one.

The Northwestern Steamship Co. has built four steamers, at a cost of $1,000,000, to trade between Chicago and Europe via the Welland Canal. The first of them the "Northwestern," sailed on April 24th, with a mixed cargo.

The "Royal City," a river steamer, owned by Mr. West, of Langley, B.C., was recently destroyed by fire, and two of her crew lost their lives. She was insured for $7,000, but the loss will be considerably greater than that amount.

The American Shipbuilding Company, of Cleveland, Ohio, is about to establish a shipyard in Montreal to put together the steel steamers built on Lake Erie and cut in two for the voyage through the canals. They may also build new vessels.

Four vessels are now being loaded in the Bristol channel, England, for Sault Ste. Marie. They will be loaded to 14 feet draught for the through trip, and will cross the Atlantic drawing 18 feet, the difference to be cargo for Montreal. Reaching Lake Erie they will take coal, to make their draught 18 feet again.

The steamer sent by La Presse, Montreal, recently to test the practicability of winter navigation of the St. Lawrence gulf had a most successful cruise. Broken ice fields and floes were ploughed through in every direction by the La Presse boat with ease. The experiment will have its influence on the minds of the underwriters and steamship owners.

Ex-Mayor Robertson, of St. John, N.B., while in England, had interviews with the Imperial authorities in reference to the construction of a dry-dock at St. John, which will be the largest on the continent. It is said the Dominion Government will give an annual subsidy of $10,000, equal to a guarantee of 1 per cent. on one million dollars.

The Clergue Syndicate's scheme for a ferry service from Manitoulin to the Peninsula is not approved of by some who claim to be experts in the navigation of Lake Huron and the Georgian Bay. The passage between the head of Bruce peninsula and the Manitoulin Island, known as the Gap is one of the most dangerous on the Upper Lakes, and with westerly or easterly winds prevailing is difficult of navigation.

The Georgian Bay Canal scheme, whose promoters are represented by Edgerley & Sawyer, have just made a proposition to the Dominion Government. This proposition is in an alternative form. If the Government will guarantee interest on the cost, estimated to be about $65,000,000, the promoters will build and allow the Government to settle the rate of passage, or the company will construct the canal on their own responsibility, provided they can fix their own rates and have control of the waterway.

The Mingan Steamship Co., of Montreal and Quebec, has a representative in England purchasing a steamer to run between Quebec and Blanc Sablon, connecting with way ports. The steamer is to be similar to the "Bruce" or "Glencoe," and to make three trips a month beginning in May, and closing the season in November each year. It is to be fitted up with a view to attract American tourists. The scenery of Northern Labrador should prove a strong attraction for visitors, provided that the comforts of travel are to be had. It is said that Lord Strathcona and Senator Drummond are interested in the new company.

LITERARY NOTES.

Under the auspices of The London Times, there is now being prepared a history of the South African war, to be completed in five or six volumes, and published through Sampson Low, Marston & Co., of London, for whom the Copp, Clark Co., Toronto, are Canadian agents. The first volume has been issued, and we can only say that if the character of the succeeding volumes is maintained and the name of the publishers will be generally accepted as a guarantee on this point—this will be the standard history of one of the most remarkable wars of modern times. The first volume contains 392 pages, with a pocket map—the best one we have seen of South Africa—and a large number of photogravure plates giving portraits of prominent figures in the events antecedent to the war. The volume deals with the history of the Boers from the acquisition of the Cape by the British to the outbreak of the war, and the schemes and political movements by which during recent years the Boer republics sought to overthrow British power in South Africa. In one aspect, the Boer war was a conflict to decide whether slavery was to be revived or extinguished in South Africa, and in treating of this aspect a remarkable series of parallels is drawn between the Boer war and the American civil war. The historical treatment is very fair, and taken altogether it is a work one can most strongly recommend.

"British Command of the Sea and What it Means to Canada," is the title of an important pamphlet by Capt. W. Woods, of the 8th Royal Rifles. The events of the past three years must have impressed every British subject with the supreme importance of naval power. Humanly speaking, the navy is the safeguard for the Empire, and the vast waterways and extensive sea-coasts of Canada give our people unequalled advantages in the matter of naval training. More attention should be paid to this subject by government and people than is the case at present, and the objects of the Navy League, under whose auspices this pamphlet is published, should receive every encouragement. The secretary of the Toronto branch of the league is H. J. Wickham, Temple Building.

The fifth edition of the Mechanics' Pocket Memoranda has been issued by the International Correspondence School of Scranton, Pa. This valuable pocket-book has compressed in its 331 pages a large amount of information, tables, etc., on the mechanical, steam, electrical and hydraulic engineering, as well as on bridge work.

Electric Wiring, by Cecil P. Poole, has been published by the Power Pub. Co., New York, and contains standard tables for wiring, with instructions for those engaged in wiring work; 100 pages with flexible cover.

The Complete Cost Keeper, by Horace Lucian Arnold (Henry Roland), has been issued from the press of the Engineering Magazine, New York. This is an important work on original lines, and should become a text-book on the subject. It goes into the whole subject of the keeping of costs in factories and engineering works, and gives the student details of plans for small factories, for medium-sized works, and for highly organized establishments; also special systems for iron works and electrical works. The system of keeping costs by cards instead of account books, is fully described and many suggestions are given in the way of mechanical aids to factory accounting. In this work of over 400 octavo pages, each step in the various systems is minutely detailed, and the subject is made clear by many engravings and sample pages of the suggested systems.

Bricklaying is the title of a new handbook of 85 pages, in which are given detailed explanations of the most approved modern methods of bricklaying as applied at the beginning of the new century. The contents are made up largely from various articles the author has contributed to technical magazines. It is illustrated by over 200 engravings and diagrams. The subjects treated of are bricklayers' tools, the laying out of work, measuring and levelling, mixing concrete and mortar, bonding walls, building angles, corners and intersecting walls, brick arches, lintels and piers, chimneys and flues, anchoring, bracing and furring walls, shoring and needling, under-pinning and sheet piling. The author, Owen B. McGinnis, is his own publisher. Address, 310 West 128th street, New York; price, $2.

Tunneling, by Chas. Prelini, C.E., and Chas. S. Hill, C.E., has been issued by the Van Nostrand Company, Murray st., New York. As there are but two books on tunneling previously published in the English language, and neither of these are suitable for text-books, the object of the present work is to supply that want at the moderate price of $3. Mr. Prelini has had wide experience in tunneling works in Europe, and his knowledge of European methods has been ably supplemented by information of Americ[illegible] methods, supplied by Mr. Hill, associate editor of The Engineering News, of New York. Among the headings of chapters are the following: Determining the centre line and forms and dimensions of cross sections, excavating machines, rock drills, explosives and blasting, excavation methods and shafts, timbering or strutting tunnels, molds employed in tunnel linings and methods of lining, tunnels through hard rock, tunnels through soft ground, open cut tunnels, submarine tunnels, the shield system, accidents and repairs, ventilating and lighting, etc. The work which is over 300 octavo pages, contains numerous diagrams of sections and cross-sections, and several tables.

The Tinsmith's Pattern Manual, by J. K. Little, C.E., has just been issued from the press of the American Artisan, 69 Dearborn street, Chicago. It is a practical manual for tinners, and gives exact instructions and explanations of the principal pattern drawings with many diagrams for patterns of all sorts of work. It instructs the tinsmith in drawing patterns for round articles of equal taper, for flat-faced equal tapering bodies, and bodies of flat and curved surfaces combined, for round articles or flat-faced bodies of unequal taper, and for unequal tapering bodies of flat and curved surfaces combined. There are of course patterns for all sorts of octagonal, polygonal, pyramidal, hexagonal and many-sided bodies, with very plain and well condensed instructions of all the figures. This is the second and revised edition of this practical treatise.

Norman W. Henley & Co., publishers of scientific books, Vanderbilt Building, New York, have issued a new and enlarged edition of the Inventor's Manual as a guide to inventors in perfecting their inventions, and in showing them how to take out their patents, and to dispose of them. The treatise deals naturally with the patent laws and regulations of the United States, but there are brief abstracts of the patent laws of other countries, and hints to inventors generally; 115 pages; price, $1.

The Decimal Association of Great Britain have issued three or four pamphlets and fly-leaves recently, showing the progress of the metric system of weights and measures. It appears that nearly 200 members of the Imperial Parliament are now in favor of the introduction of the metric system, and every month brings new accessions to the movement from school boards, technical and scientific institutions, commercial and manufacturing associations, etc., and the compulsory adoption of the system is only a question of a short time. These facts should not be lost on Canadians. Sir Samuel Montagu is president, and Edward Johnson, secretary, of the Decimal Association, whose office is Botolph House, East cheap, London, Eng.

Modern Methods of Saving Labor in Gas Works, by C. [illegible] Brackenbury, A.M. Inst. C.E., has just been published by J. S. King & Son, Westminster, London, Eng., at 3/6, net. The author in a series of articles in The Engineering Times has already shown the [illegible] and manufacturing corporations of England some of their short comings, and has pointed out a remedy for a number of these failings. The present treatise an illustrated volume of 64 pages, enlarges on the subject, and describes the most modern methods and machinery for the production of both coal gas and water gas. The subjects of inclined retorts and horizontal retorts and machinery for the same, also coke plants, are gone into, and are elucidated by 56 engravings and diagrams.

Other publications received are: Minerals for the Paris Exhibition, by Dr. E. Gilpin, inspector of mines for Nova Scotia. Provincial Government Report, Halifax.

Escape in Case of Fire, by Chas. Baillairge, C.E., Quebec. Progress of the 19th Century, by Chas. Baillairge, C.E., Quebec.

Industries of Sault Ste. Marie, by John Waddell, D.Sc., School of Mining, Kingston.

Papers read before Engineering Society of the School of Practical Science, Toronto; 204 pages; 50c.

Halifax, descriptive sketch of the Garrison city, published by the N.S. Tourist Association, Halifax, N.S.; free.

Annual report of the city engineer, Halifax, N.S.

Description of Electrolytic Laboratory, University of Pennsylvania, by A. W. Schramm.

Fire Tests with Doors—Paper No. 50 of Experimental Tests, published by British Fire Prevention Committee, 1 Waterloo Place, Pall Mall, London, Eng.

Address by Dr. H. T. Bovey, president, Can. Soc. of Civil Engineers, delivered at the annual meeting, January 24, 1901.

CATALOGUES RECEIVED.

Copies of these catalogues will be sent free, to those interested, on application, mentioning The Canadian Engineer.

Fort Wayne Electric Works, Fort Wayne, Ind., catalogue of the Wood direct acting shunt feed series arc-lamps.

Ransome & Smith Co., 19 Ninth street, borough of Brooklyn, New York, N.Y., catalogue of patent concrete mixers.

The Dodge Mnfg. Co., Toronto, booklets of testimonials from users in all parts of Canada of the Dodge split friction clutch.

The Geo. White & Sons Co., London, Ont., catalogue of agricultural engines, straw burning boilers, cheese factory boilers, portable saw mills, etc.

Wm. R. Perrin & Co., Church street, Toronto, catalogue No. 7, describing filter and hydrauiic presses, screw and knuckle-joint presses, steam and air presses, etc.

Keystone Mnfg. Co., Buffalo, N.Y., catalogue No. 12, describing Keystone and Monarch ratchet drills, the original Westcott adjustable "S" wrench, boring tool holders, steel sockets for taper shank drills, etc.

North Bros. Mnfg. Company, Philadelphia, Pa., catalogue of ice cream freezers, ice cream packing cans and appliances; also from same firm catalogue of "Yankee tools," such as screw drivers, automatic drills, reciprocating drills, etc.

M. Beatty & Sons, Welland, Ont., mnfrs. of contractors' plants; illus. 84 page pamphlet, describing the firm's special makes of steam dredges, derricks, shovels, hoisting engines for horse or steam power, gang stone-saws, centrifugal pumps, drilling boats, pile-drivers, cable-ways, sand pumps, derrick irons, chains, etc.

L. Leonard & Sons, engineers, London, Ont., new catalogue of engines, boilers, etc., manufactured by the firm including the Peerless self-oiling automatic engine, Leonard-Ball automatic, Leonard Tangye, Leonard-Clipper, and vertical automatic engines; standard tubular boilers, semi portable boilers locomotive boilers, Lancashire boilers, dairy and cheese factory boilers, etc.

At the annual meeting of the Colonial Bleaching and Printing Co., of St Henri, Que., to be held this month, the question of building a cotton mill to supply the company's print works with grey cotton will be discussed.

J. G. Terry, accountant; E. H. Crandell, agent; Robt J. Hutchings, manager, all of Calgary, N.W.T., have formed a joint stock company, known as the Calgary Tent and Mattress Co., with a capital of $10,000, to manufacture tents, mattresses, bedding, and similar goods

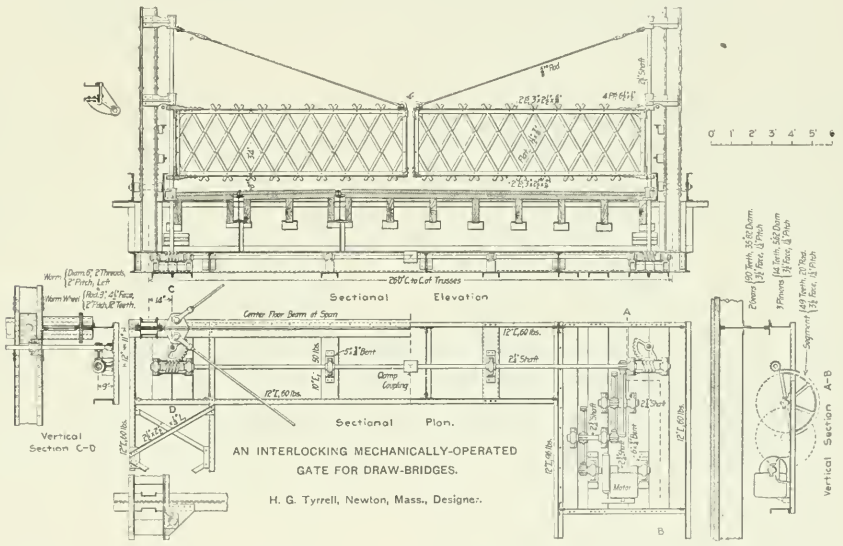
INTERLOCKING, MECHANICALLY OPERATED DRAW-BRIDGE GATE.

By H. G. Tyrrell, C.E., Boston, Mass.

Frequent accidents at open draw-bridges has prompted the writer to invent a mechanically operated gate designed to furnish a complete safeguard against disasters. The essential idea of this design is that the bridge and the gate cannot be open at the same time. The first cost of these gates is, of course, high in comparison with the first cost of the ordinary style of hand-operated gates, but they dispense with the services of a gateman, and for this reason should be economical in the long run.

The accompanying drawings show a pair of gates applied to a bridge with approach spans at either end, and having a 26-ft. roadway and no sidewalks. The design can, however, be modified to suit any width of bridge, with or without sidewalks. The gates are keyed to vertical shafts, which are shown turning in boxes fastened to the web posts of the fixed span. At the foot of these shafts are toothed segments worked by worms, which lock the gates in any position. These worms turn in oil baths, as shown. The worm shaft is connected by a system of reducing gears with the motor. In this system of gears is included a half-gear, which insures a movement of 90° only to the gates, and at the same time gives the operator a few seconds leeway in shutting off his power from the gate motor. Power is supplied by an electric 3-h.p. enclosed motor, shown in the lower right hand corner of the drawing, and this receives its current from wires on the draw span, through contact plates. When the gates are closed and the draw span is swung open, the electric connection is broken and the gates cannot be moved. Hence, the gates are controlled entirely by the operator on the draw span. The service of one man only is required on the bridge at any one time. The gates are always locked in every position, either open or closed. As an extra precaution they may be placed say 100 feet from the draw span. Then, should a car or train break through them, it would certainly come to standstill before reaching open water. As a further precaution a de-railing switch may be placed inside the gates, then in case of a car breaking through the gate, it would be thrown from the track and stopped, rather than pitching over the end of the bridge. This switch may be operated by the gate motor through a series of wheels or levers. At all times the roadway should be well lighted and the gates themselves painted white so that they may be more easily seen. Danger lights should be located on the gates, showing white when open and red when closed. It is desirable to have these located sufficiently high above the floor that they may be plainly seen above a crowd. An estimate, based on the accompanying plan and including both ends of the bridge, is as follows:

Weight of gates	2,100 lbs.
Weight of machinery	5,600 lbs.
Weight of machinery support	5,200 lbs.
12,900 lbs. at 5c.	= $645
Two motors, 3-h.p.	= 300
Total cost	$945



ICE-BREAKING STEAMERS ON THE ST. LAWRENCE.

Before a large gathering of the Canadian Society of Civil Engineers, at Montreal, on March 28th, John Kennedy, the Montreal Harbor Commissioner's chief engineer, read an instructive paper on Ice-breaking Steamers, and the feasibility of their use in keeping open the St. Lawrence for later or earlier navigation than at present. The nature of the ice on that river differs much from that of other waters where ice-breakers are now in regular use, and the difference is in favor of the St. Lawrence; where a swift flowing stream, without back or tidal currents in the upper reaches of the river, below Montreal, would render the disposal of broken ice an easy matter. The inlet and outlet channels of the lakes are the chief difficulties, because it is at these points that the ice mostly forms in solid weight. The downward drifting ice gathers at these points, and in a short time causes the irregular sheets of ice to back up the river. In the springtime the river gathers volume, and the ice is held as in a wedge at the narrow inlet of the lakes, and ice jams and floods are the consequence.

The Mackinaw ice is fresh water ice on a lake without current or ebb or flow, and consequently liable to freeze to greater solidity. In the Delaware and Chesapeake bays the daily tide tends to thicken the ice, and the same conditions hold good on the Baltic, yet in each of these three places ice-breaking steamers have been working for some years now, with considerable degrees of success, making navigation comparatively easy and regular, and giving access for ocean vessels to Philadelphia and Baltimore, and the Baltic ports. In the lower St. Lawrence and in the Gulf the conditions are somewhat similar to the above.

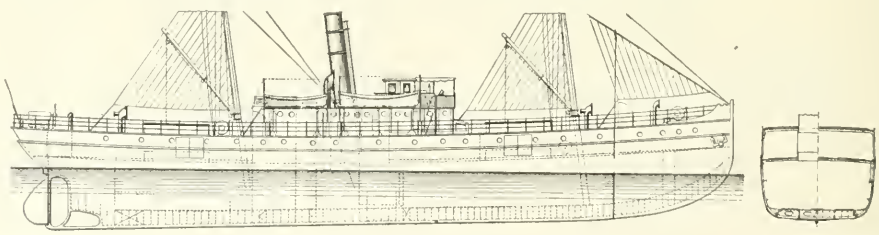
It is contended that were the ice in the St. Lawrence lakes kept from forming at the inlets or narrow channels, the floating ice brought down the river would flow to the Gulf, and the formation of thick ice of the river would be prevented. To effect this, ice breaking steamers of sufficient power and

weight, both being important factors, should run through the channels regularly preventing the ice from forming to any considerable thickness, and so stopping the downward flow of broken ice from the upper river.

The evolution of ice-breaking vessels has developed steamers that can plough through ice of considerable thickness with almost as much ease and speed as an old-fashioned boat could sail through the waves. The early Quebec ferry boats were used all the year round, and for many years no alteration of keel or sloping the sides was made. But as the experience of various ice-breakers was compared, a special type of boat, suitable for the work, was evolved, varying somewhat in the American and European types, but agreeing on essential points. The weight of the boat being an important item in ice-breaking, a corresponding strengthening of the bow and sides, with the overhang of the former enlarged, and the slope of the latter reduced, was found to be desirable. In the actual working of an ice-breaker, the bow of the boat rises slightly and her weight overcomes the resistance of the ice, which then breaks; the steamer progressing by repeating this operation. In cases, where the ice is not of very great thickness, this progression is steady and regular, producing little or no jolting sensation. When it is too thick to allow steady progress, the vessel retires a length or two and charges against the ice at full speed. The problem of how to dispose of the ice so broken, and also to clear away drift or pack ice, has led to the introduction of a forward as well as a rear propeller. As the vessel rests her bow in the ice, the forward propellor sends a stream among the pack or broken ice, loosening the grip of the separate blocks, which are carried away by the steam so produced. The after propeller is all the time kept working, thus keeping the vessel against the ice.

Steamer Ste. Marie, with Propeller at Bow and Stern—Showing Curves of Bow and Stern.

Ice Breaking Steamer Sampo—Showing Curves of Bow and Stern.



Steamer Aegir—Combined Trader and Ice Breaker.

The diagrams of the "Ste. Marie," built by the Detroit Dry Dock Co., and the "Sampo," built by Armstrong, Whitworth & Co., of Newcastle, England, show the variation of the American and European type of boat

The "Ste. Marie," which is a ferry boat as well as an ice-breaker, can carry 17 to 18 cars, and has propellers fore and aft. Her dimensions are length, over all, 305 feet; breadth, 52½ feet; draft, 17½ feet; foreward engine, 1,200 h.p., and aft engine, 1,800 h.p.

The "Sampo," an excellent ice-breaker only, with propellers fore and aft—length, over all, 200 feet, breadth, 42 feet, draft, 18 feet; with triple expansion; engines of 3,000 h.p.

The "Aegir" s an excellent type of a combined trader and ice breaker, with stern propeller only, for the Baltic trade Length, over all, 182 feet; breadth, 28 feet; draft, 14 feet 6 inches; with compound engines of 500 h.p.

Mr. Kennedy pointed out, in conclusion, that the feasibility of keeping the St. Lawrence open later in December and earlier in the spring was beyond question, and the practical issue was a mere question of expense. The extra time gained for navigation at Montreal (say one month), would bring harbor dues, at the average rate of income, about $36,000. But as the ice-breaking steamer of good type is a costly article, the authorities here would weigh the gain and cost with practical minds.

In the discussion, which followed, Col. Anderson (of the Department of Marine and Fisheries), pointed out that it would be difficult to retain the channel buoys in their position amidst masses of drifting ice, and without these marks, navigation would practically be impossible.

Mr. Sproule advocated a system of anchorage points built above water level for holding fast the fields of ice, which form in the lakes, and which, when loose, directly assist in the formation of ice jams, especially at Cape Rouge. Such anchorage points in the Laprairie basin would effectively hold the ice there and prevent floods at Montreal. They would prove a cheap and reliable substitute for the piers or booms recommended by the Montreal Flood Commissioners of 1886—87.

D. W. Micewicz is organizing a company to erect a flax-seed mill at Edmonton, N.W.T.

The by-law to bonus a flax mill at Tilbury was carried by the electors.

The Canadian Engineer has issued a chart of the metric system of weights and measures, showing on one sheet, 14 by 40 inches, the whole system, with English equivalents. Mailed free at 10 cents.

WANTED—A Mechanical Draughtsman. One accustomed to general machine design preferred. Address D. B., care of Canadian Engineer, Montreal, P. Q.

Position Wanted by Electrician; competent wireman and lineman, experienced in both steam and water power, electric light and power plants; can give best of references or will go on trial. Address G. H. C., care of The Canadian Engineer, Toronto.

JAMES LANG

Mechanical Engineer and Practical Draughtsman

Plans, Specifications, Estimates, Working Drawings, Tests, Inspection, Superintendence.

57 Canada Life Building, TORONTO

Telephone Main 3399

PATENT NOTICE

Thomas Albert Darby and Sidney Charles Darby, both of Pleshey, Essex, England, the owners of Canadian Patent No. 55,433 for improvements in Cultivators, are willing to grant licenses for the use of said invention or otherwise to supply same. The owners are also willing to sell the Patent outright. Applications should be made to OWEN N. EVANS, Solicitor of Patents and Expert, Temple Building, Montreal. 4-1

The Canadian Engineer

VOL. VIII.—No. 14. TORONTO AND MONTREAL, JUNE, 1901. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 1392. Montreal Telephone, Main 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE		PAGE
Canadian Electrical Association	322	Magnetic Iron Sand of St. Lawrence	313
Catalogues Received	325	Marine News	318
Chartered Companies, New	xiv	Metric System in England	iv
Chicoutimi Dam Failure	310	Metric System, The	325
Chimney Versus Fan	320	Mineral output of Ontario	iv
Coal Shiping, Wire Rope System of	xxxiii	Mining Matters	316
Edison's New Storage Battery	321	Miscellaneous Notes	327
Electric Flashes	318	National Elec. Light Association	325
Engineers, Ont. Ass. of Stationary	324	Ont. Ass. Stationary Engineers	324
Engineers and Surveyors	326	Pacific Cable	309
Fleming, Sir Sandford	309	Personal	326
Fuel and Power of Canada	322	Railway Matters	317
Heating a Public Building	319	Sewage Disposal	323
Hydraulic Presses	319	Storage Battery, Edison's	321
Industrial Notes	315	Sturtevant B. F. Co's	iii, xvii
Inspection of Boilers	307	Switchboard Equipment, Modern	311
Lachine Rapids Power Plant	301	Valves, Copper-Alloy Disc	324
Literary Notes	326	Water Power Development at Chaudiere Falls	307
London Machine Tool Co. Lathe	xiv	Wire Rope System of Coal Shiping	xxxiii
Lubricator, Imp. Gas Engine	324		

The Hydraulic-Electrical Developments of Canada.

The special articles which have been appearing in the Canadian Engineer on the hydraulic-electrical power developments of Canada will be continued, so as to include all the great works now installed or in process of installation in this country. These will be republished in book form and will make a unique practical text book on the subject. The price of this valuable work has not yet been fixed, but it will not exceed $5 per copy and may be less Orders in advance will now be received.

THE LACHINE RAPIDS POWER PLANT.

The problem of utilizing the power of the St. Lawrence River at Lachine Rapids, near Montreal, was one which had for many years engaged the attention of engineers and capitalists. Their almost unanimous opinion was, however, that although considerable power could be obtained during the summer months, the drowning of the rapids during high water would so reduce this that any scheme requiring continuous power the whole year round would not be feasible. Support was given to this idea by facts observed during the running of a small grist mill erected on the site, for which power was obtained by throwing out a small wing dam. This mill was compelled to shut down during a part of the winter, owing to back water. Another serious objection was that great quantities of frazil or anchor ice run through the rapids almost all winter, and it was thought impossible to prevent its filling up the head race and wheels. About six years ago, T. Pringle & Son, and W. McLea Walbank, of Montreal, after a careful study of the question, came to the conclusion (which has been proved since the river bed has been laid bare), that the backing up of the water and drowning of the rapids was caused by the great bars of rock which rise out of the river bed at an acute angle, facilitating the collection of frazil and the formation of natural ice dams.

The Lachine Rapids are probably the most famous of the series of St. Lawrence rapids from Lake Ontario to Montreal. Every one who has ever taken the steamer trip down them, which is one of the most enjoyable experiences of every pleasure-seeker's visit to that city, will recall the rock barriers, which make their presence manifest to the practised eye by the turmoil of the waters, even when wholly submerged. Above the rapids the river widens into a broad expanse, known as Lake St. Louis, some six miles wide and 14 miles long. The rapids themselves are about five miles in length, and their total fall is about 30 feet. Briefly stated, the plan for power development, which has been carried out by the Lachine Rapids Hydraulic & Land Co., was to project a dam into the stream at a point about one mile above the foot of the rapids, and by a dike parallel to the river bank, and extending up stream 5,000 feet from the river end of this dam, to make a broad head race, which will take water from a point where the water on the rapids is about 11 ft. higher than the dam. Below the dam there is a further fall of about 10 ft. in a distance of about a mile to the foot of the rapids. The works are designed to utilize 15,000 cubic feet of water per second, which will be about 10 per cent. of the entire flow of the river at low water. The general map of the rapids shown gives a good idea of the location of the company's power plant with reference to the rapids and the city of Montreal.

GENERAL DESCRIPTION OF WORKS.

By reference to the general plan (Fig. 2), it will be noted that the present scheme, as carried out, consists of: (1) A head race 3,705 feet long, formed by a wing dam composed of a 40-foot masonry ice breaker at the entrance, 3,305 feet of overflow cribwork, and 360 feet of cribwork carried up square to the same level as the top of the piers of the main dam. (2) A main dam of 43 masonry piers on concrete foundations, the piers being 4 feet thick and 17 feet high above the level of the floor of the flumes and the top of the foundation. The piers form 36 flumes, three waste weirs, and the foundations for three power houses. (3) A guard dam forming the tail race, consisting of 300 feet of cribwork 10 feet wide and 900 feet of embankment formed of rock taken from excavations. (4) A system of booms and cribwork piers designed to keep the wheels clear of floating ice, driftwood, grass, etc.

The head race is excavated to a depth of 12 feet below the top of the overflow dam, and is at the nar-

rowest point near the entrance 525 feet wide, with a sectional area of 6,300 square feet, so that, allowing a discharge of 200 cubic feet per second from each wheel, or a total of 14,400 cubic feet for 72 wheels, the velocity of flow past this point will amount to about 2.3 feet per second. As the head race widens out to nearly 1,000 feet at the flumes, this velocity will, of course, be much reduced, so that there will be little, if any, lost head due to an excessive speed of current.

The current in the river, just above the entrance to the head race, runs at the rate of about six miles per hour, and this striking a body of water moving at the rate of only two-thirds mile per hour, will give it a tendency to strike almost directly outwards, carrying with it most of the frazil, driftwood, etc., that it may contain. It is also a fact that the current has always had a tendency to strike outwards at this point, owing to a curve in the river bank just above the head race entrance.

The water in the head race will freeze over completely in winter; and, as is well known, no frazil will form under the ice; but should any commence running before the ice forms, the racks are so hinged and arranged that they can be lowered to the bottom, or taken out completely, allowing it to run through the wheels. The crib piers and booms are so arranged that there will be no danger of the ice shoving down on to and destroying the racks. Whatever ice forms in the head race will go through the waste weirs without trouble.

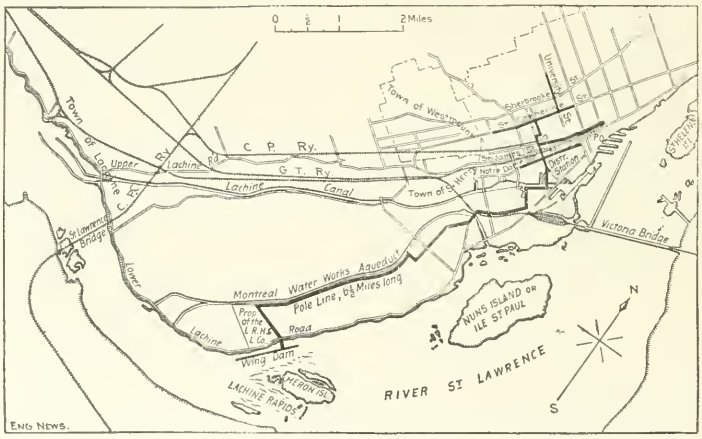


Fig. 1.—Map showing the location of the Power Plant and Pole Line of the Lachine Rapids Hydraulic and Land Co.

CONSTRUCTION OF FALSE DAMS.

Work was commenced in the fall of 1895 by throwing out a false dam (Fig. 2) of stone and earth at right angles to the shore; then by running a short wing dam down stream, enough of the river bed was made bare to enable the contractors to get sufficient stone by excavation to grade to continue the dam further out into the river, and to commence running a wing dam down to the site of the main dam, on which are the wheel houses. Every foot added to the wing dam down stream, laid more of the river bed bare and allowed excavation to be made down to grade. This work was carried on during most of the winter by means of steam drills, and the rock taken out was used to construct another dam (Fig. 2), at right angles to the shore, 150 feet above the extreme upper end of the proposed wing dams. These two false dams were connected during the next season, and when they were sufficiently advanced, an opening was made in the lower dam, and the water in the upper portion drained out, enabling the whole of the work to be done on a comparatively dry river bed.

Much trouble was experienced in building these dams, owing to the raging current which at several places swept away 75 per cent. of the material, consisting of large boulders, etc., as fast as it was dumped in. The fact of their having been built of such large stones also gave the dams a tendency to leak badly in spite of banking with earth mixed with pea-straw, etc.

CRIBWORK.

The cribwork dams were then commenced. These consist of first, a high crib 360 feet long (Fig. 6), built of 12 x 12-inch face timbers laid to 2-inch joints with 8-inch flatted ties laid 8 feet apart in each course, and 8-inch longitudinals; and, second, 3,305 feet of overflow crib with 12 x 12-inch longitudinals and purlines. The top is hipped up with an easy slope on the shore side and covered with 2-inch plank and 8-inch tamarac split poles with the bark on. The slope on the side towards the river is steeper, and is covered with 8-inch tamarac squared on three sides and laid on purlines. The vertical face of the whole dam on the shore side is sheeted with two layers of 2-inch plank and an ample talus of gravel is laid along the shore side. Both cribs are filled with carefully placed stone of moderate size, and are scribed and bolted to the rock when above the grade adopted for the bottom of the head race, 12 feet below the top of the main dam. Below this it is considered that the stone filling is ample security, and the cribwork is merely scribed to fit closely to the rock. The wing dam cribwork, above the main dam, is 20 feet wide at the bottom, and the cross ties are run entirely through wherever possible.

The masonry ice-breaker at the upper end of the wing dam is 40 feet long and 20 feet wide; it is built on a concrete foundation two-thirds the depth of the water (which is 21 feet deep at this point), of rough, bush-hammered masonry. The top is bevelled to 5 feet

below the water line, and 1½-inch chains are imbedded in the concrete to fasten the upper boom.

MAIN DAM.

The main dam piers are built of rough, bush-hammered masonry, 4 feet thick, laid on concrete foundation 4 feet 6 inches thick, which runs up to the level of the flume floor. The rock under the wheel pits was first excavated and levelled off, and owing to its shaly and unreliable nature, a layer of concrete 1 foot thick, composed of 2 parts sand, 1 part Portland cement, and 6 parts stone (these proportions were used throughout the work), was laid over it, holes being left to receive the columns supporting the flume bottoms. Caissons of 2 x 4-inch stuff, laid on the flat and well tied through, were then run up to the level of the underside of the timbers supporting the flume floor. These timbers of 12 x 15-inch pine were then laid, running back 15 inches into the concrete, and were bevelled off so as not to weaken the foundation.

The caissons were brought up to the level of the flume floor and filled with concrete. Two longitudinals of 10 x 12-inch British Columbia fir were run under the floor timbers, and 15 inches into the caissons along the front of the flume. These are each supported by six 6-inch I-beam columns placed in holes in the wheel pit bottom, above mentioned, which were then flushed up. Masonry was then laid on this foundation to a height of 17 feet above the flume floor. This masonry is of a very high-class character, the blocks being extremely large and averaging about 2 feet in thickness; they are laid in cement mortar, composed of 2 parts of sand to 1 of cement.

Two recesses, 12 x 8 inches, 36 feet apart, are provided for the gates and stop logs, the down-stream one being 6 feet from the back of the piers, and the up-stream one being 4 feet from the front of the piers. The piers are 4 feet thick by 48 feet long, 21 feet 6 inches c. to c. for both flumes and waste weirs.

POWER HOUSES (FIG. 9.)

The power house walls are built in a similar manner, and contain between them massive concrete foundations for the generators. The walls are four feet thick along the front and sides to the line of the down-stream end of the piers; beyond this the masonry is only 3 feet thick and 3 feet high, with a 16-inch brick wall up to the top of the piers. The generator foundations are constructed in the form of heavy columns with arches between, and afford every facility for getting at the holding down bolts of the generators. Vacant spaces between and behind the foundations are filled with stone flushed over with eight inches of concrete up to the same level as the flume floors or tail water. These spaces will be utilized for heating apparatus, storage, etc., and will be accessible by a spiral staircase and a hatchway 4 x 5 feet.

SHORE ABUTMENT.

The shore abutment (Fig. 15), is also built of masonry four feet thick, and from the line of the rack runs into the bank in a sloping direction. This sloping portion is backed with three feet of clay puddle up to the frost line, four feet below the ground level. There is also a wing wall 12 feet behind this of concrete, three feet thick, running 23 feet into the bank. The portion of the abutment next the flume is backed with concrete four feet thick, running up 6 feet above the flume floor, and with clay puddle 3 feet thick above this up to the

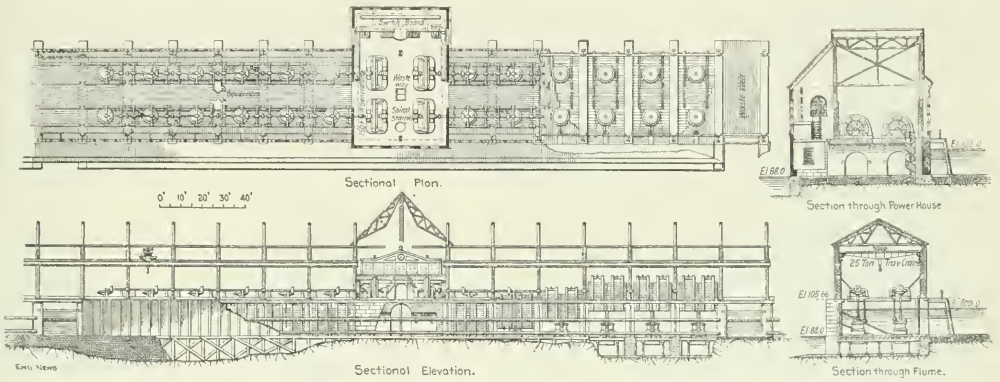


Fig. 9—Divisions three and four of Main Dam, showing plan, elevation and section of Power House and turbine settings.

frost line. These precautions are taken to preclude any possibility of leakage around the back of the abutments. A cribwork embankment is carried along the shore from the corner of the abutment to a point about 50 feet up-stream. All ties in this crib are kept so that the ends will be below the frost line.

WASTE WEIRS (FIG. 10).

The floor timbers and flooring for the waste weirs are finished in the same way as the flumes; 12 x 12-inch stop logs are laid in the up-stream check, and the upper four of these can be taken out and replaced to suit the level of the head water. A heavy timber slide is built over the floor for ice, etc. Arrangements were made to drain the water through the waste weirs under the flooring during construction. This was done by omitting the concrete wall along the front from the rock bottom up, and by placing slides into which one set of 12 x 12 stop logs, and one set of 2 x 4 stop logs were dropped and the space between filled with concrete, when the construction was completed.

HEAD GATES.

Each flume is provided with a set of two head gates of pine, 5 inches thick, for a height of 5 feet, and 4 inches thick above, with an iron sliding filling gate in each, and two 8 x 4-inch uprights with a cross piece between fitted with wrought-iron shackle to raise the gates by. The head gates move in slides fitted into the check in the masonry and fastened to an upright in the

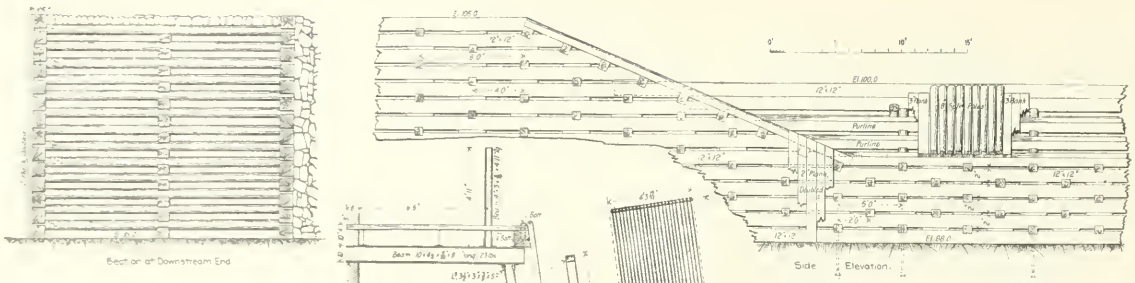


FIG. 6. CRIBWORK OF WING DAM AND GUARD PIER.

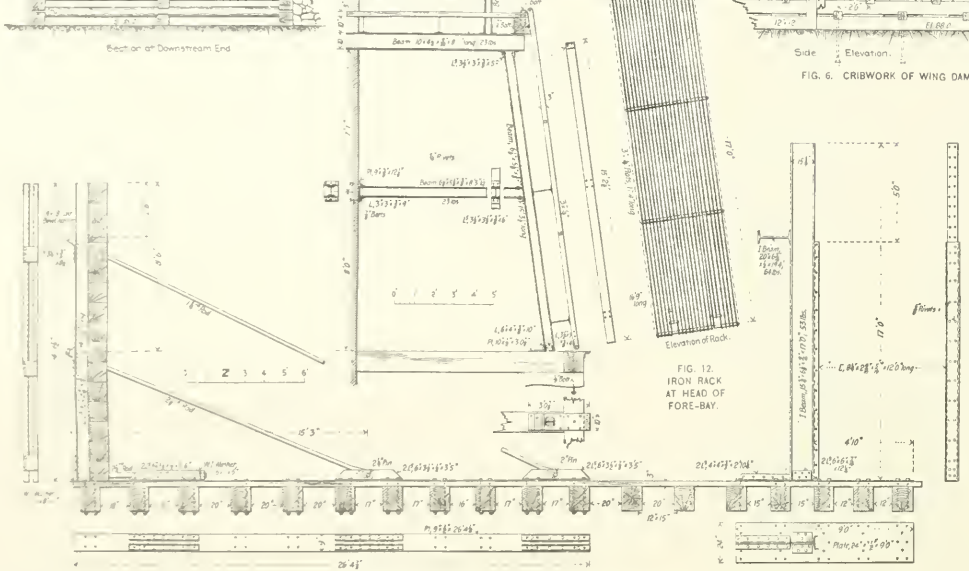


FIG. 12. IRON RACK AT HEAD OF FORE-BAY.

FIG. 11. DETAILS OF FLUMES SHOWING STOP LOGS AND STAYS.

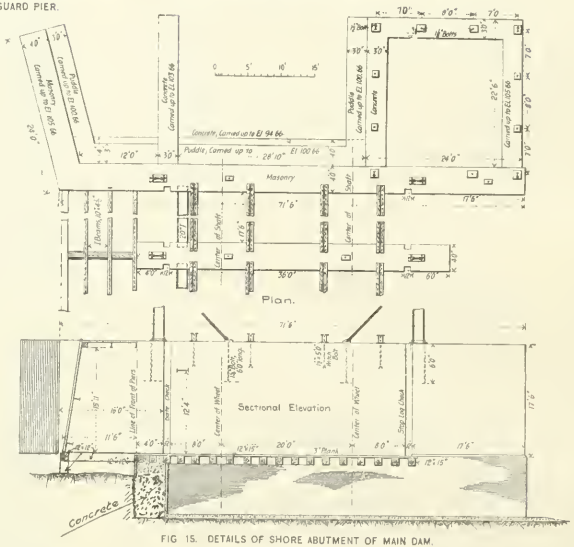


FIG 15. DETAILS OF SHORE ABUTMENT OF MAIN DAM.

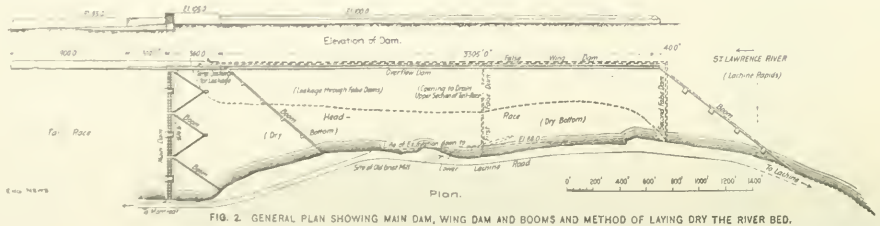


FIG. 2. GENERAL PLAN SHOWING MAIN DAM, WING DAM AND BOOMS AND METHOD OF LAYING DRY THE RIVER BED.

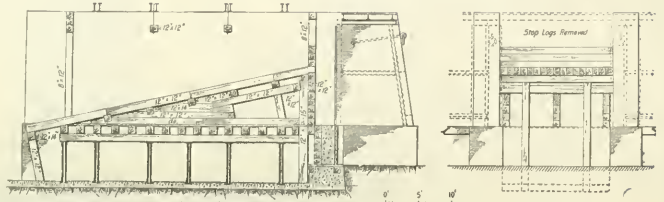


FIG. 10. DETAILS OF A WASTE WEIR IN MAIN DAM.

WATER POWER PLANT AT THE LACHINE RAPIDS, MONTREAL, CAN.

centre of the flume, consisting of a 15-inch I-beam and an 8-inch channel into which a strip of wood is fitted, and to this the distance piece between the two gates is screwed. This upright is braced just at the water line by a 20-inch I-beam running across the flume and 11 inches into the wall on each side; it is securely fastened at the bottom to an iron plate nine feet long, two feet wide, and half-inch thick, rag-spiked to the floor timbers.

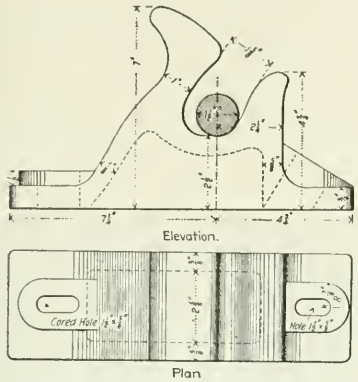


Fig. 13.—Castings forming hinge support of rack for protecting the Turbines of the Lachine Rapids Power Plant.

The gates are intended to be raced and lowered by a traveling crane, and will probably be taken out and stored under water after the wheels commence running, as they would obstruct the light if left in position. The space between the top of the gates and the flooring of the building is filled with three-inch plank laid in the check and bolted to the upright behind the gates.

STOP LOGS.

The stop logs (Fig. 11), are 12 x 12 inches, laid into 8 x 12-inch, recesses in the piers, and braced by two sets of iron eye bolts, three in each brace, running diagonally down to the flume floor and pin-connected to the angle-iron fastenings, which are riveted to an iron plate 9 x ½-inch x 26 feet 4 inches bolted to the floor timbers. These bolts run out to a bevel casting, bearing on the channel iron uprights, and are provided with a nut at the outer end and can be removed if necessary. The uprights are formed of two 10-inch channels placed back to back with a space for bolts between, and held together with cross plates just under the bevel castings. These braces are so placed as to take all strain off the masonry piers.

RACK AND BRIDGE.

The rack and bridge framing rests on 12 x 12-inch timbers running lengthwise of the main dam, and 11 feet 6 inches from the front of the piers, well supported by 12 x 12 uprights; a butting piece is placed at each pier and braced where necessary by 3-inch plank. This framing is laid level with the flume floor and is omitted in front of the waste weirs. The rack and bridge rest on steel frame-work constructed of 6-inch I-beam uprights, 12-inch I-beams, running lengthwise between piers to support the racks, while 10-inch I-beams are under the bridge floor, which is about 6 feet wide. The outer one of the bridge beams is faced with a 10-inch timber against which the rack rests. The rack (Fig. 12), is made of 3 x ¼-inch bars, 17 feet long, laid to 2¼-inch centres in sections 4 feet 3½ inches wide, well bolted through and with thimbles between each bar. Each section is supported on two castings (Fig. 13), so shaped that the rack may be swung over so as to lay on the head race bottom (which will be levelled off in readiness), or it can be easily taken out and replaced without the necessity of sending down a diver to unfasten the bolts. The rack is constructed in this manner so that it may be taken out of the way in order to pass frazil through the wheels, in case the frazil should begin running before ice forms over the head race. If the rack were permanently secured in the ordinary way, the frazil would adhere to the rack bars and impede the flow of the water. The bridge beams are floored over with 2-inch plank, and a rail is carried along the bridge about 2 feet from the edge, giving ample room for a man to rake the rack.

BOOMS.

The system of booms (Fig. 2), as designed by T. Pringle & Son, was as follows: (1) At the entrance to the head race, on a very easy rake, was to be placed a boom 1,340 feet long, constructed in the form of a Howe truss, the chords being three 12 x 12-inch timbers. The main braces 3-inch plank, and the counter braces 4 x 12-inch timbers. The 3-inch plank was laid solid on the top and bottom, and between the 12 x 12-inch timbers and the 4 x 12-inch timbers were placed on edge between the layers of plank. The whole was securely spiked and bolted every 8 feet with three bolts, one through each 12 x 12-inch timber, the bolt diameters varying from 1¼-inch to 1¾-inch. The boom was in sections 250 feet long, with a clear span of 220 feet, and was 14 feet wide and 4 feet deep. Its details are illustrated in (Fig 16). It was to be securely fastened to the shore and the ice-breaker, and supported by four crib piers, 30

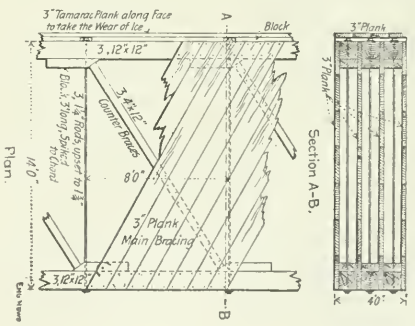


Fig. 16.—Howe Truss forming boom across head race.

feet square, constructed of 12 x 12-inch timbers and filled with stone. These cribs are made large, as they stand in about 25 feet of water. (2) At the lower end of the overflow dam will be placed a boom 1,000 feet long, constructed of three 12 x 12-inch timbers fastened with 1¼-inch chains and 1¼-inch bolts. This boom will be secured to a timber sunk into the ground at the shore end, and will rest against a buttress on the overflow dam. It will be supported by four crib piers, 13 x 22 feet, the fronts of which are at a slight angle to the sides, so as to obstruct the flow as little as possible. (3) At a distance of 250 feet from the front of the main dam are placed two piers, 13 x 22 feet, with

ice-breaking faces and constructed of 12 x 12-inch timbers.

Booms constructed of two 12 x 12 timbers, with bolt and chain fastenings, are secured to these, and inclined to the waste weir entrance, forming a complete protection against any trash which may be allowed to pass the second boom (if the water level ever falls below the top of the overflow), and against ice which may form in the head race up to the second boom. All the boom piers are provided with suitable snubbing posts capped with galvanized iron and are filled with stone.

All the piers necessary for this system were placed in position, but on completion of the work the directors of the company decided to dispense with the truss boom at the entrance. The small angle booms leading to the waste weirs were placed in position.

TURBINES.

Each flume will contain (Fig. 9), two special 54-inch Victor turbines, a total of 72, which are connected in sets of six turbines to twelve generators, four in each power-house. These wheels are set vertically on 3-inch plank flooring, and will develop 200-h.p. each, under a 11-foot head, a total of 14,400-h.p. Under this head they will run at 64 revolutions per minute, and discharge 12,000 cubic feet of water per minute. Each set of six wheels is connected by bevel core gears to a common jack-shaft, and this transmits their power at a speed of 175 revolutions per minute to a 3-phase generator of 750 K.W., guaranteed to stand 25 per cent. overload. The speed is regulated by Lombard governors. A single line of shafting from the governor, directly connected by rocker arms, and vertical rods to the cylinder gates of the turbines, operates all of the gates simultaneously. Counterweights to assist the governor shaft in lifting the gates are attached to the outer end of the rocker arms. This simple and ingenious arrangement does away entirely with the usual gearing in the flumes. Its operation is entirely satisfactory. The gears and shafting from the turbines are supported on heavy cast-iron saddles resting on 15-inch I-beam girders, two beams to a girder, bolted at the ends to the piers by bolts running 42-inches into the piers. These girders also support by stirrups 8-inch I-beams on which the gear-shed flooring of 3-inch plank lies. This flooring is so arranged that the stop logs may be taken out and hatches are hinged over the space required to take out the head gates. At the back and front of the gear-shed beyond the ends of the 8-inch floor beams, the flooring rests on 12-inch timbers.

GEAR SHEDS.

The gear sheds are of steel frame with peak roof, Fink truss design. The uprights at each pier are lattice columns and are arranged to carry 21-inch I-beams on which a 25-ton hand-power crane runs from end to end of the building, a distance of 975 feet. The distance from the floor to the eaves of the shed is 25 feet, to the peak, 30 feet, and the distance between uprights, or the clear width of the shed inside, is 38 feet. A wooden sheathing of studding and planking runs along the sides covered with corrugated iron. Between the roof trusses, which are 21 feet 6 inches apart, 6 x 12 inch purlines are laid. Over these are laid two layers of 1¼-inch boards, with two-ply 10-ounce roofing felt between, and the whole covered with four-ply plastic asphalt.

POWER HOUSES.

The power house (Fig 9), are built of steel frame, and the roof is of special design, distance to the peak being 50 feet; 12-inch brick walls are carried all around the front, back and sides, except where the traveling crane passes through, above which a wooded partition will be run up with doors to close when the crane is not in use. Loads carried by the crane will pass through openings 12 feet wide on each side and in centre. The inside dimensions of the power houses are 64 x 44 feet. The flooring is of concrete, covered with 1-inch slate to prevent dust rising from the concrete.

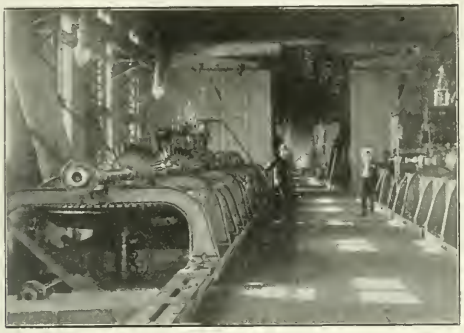
The generator foundations form the flooring as far back as they go; beyond them 12-inch I-beams are laid with terra cotta between them over which three inches of concrete and slate is laid. A hatchway, 4 x 5 feet, and a spiral stairway is provided for access to the vault-like recess below the generators and pipes, to carry the cables to the switchboard, etc., run through the floor. On the massive arched foundations are placed the generators; these stand 11 feet high above the floor, have a base 15½ x 10 feet, and weigh about 45 tons each. They are held down by four 2¼-inch bolts 12 feet long, which can be readily taken out if required. Two stone blocks, 30 x 24 inches x 16 feet, are placed under the generators, one at each side. Two 4-pole exciters of 75 K.W., capacity were placed at the down-stream end of the power-house. They were belted to the main shaft, and served two generators, but either of them was capable of exciting four generators. The bases of the exciters were securely bolted down to the I-beams on which they rested.

GENERAL.

There have been used in the work at the Rapids, up to commencement of operation, 8,700 cubic yards of concrete, 6,000 cubic yards of masonry, and 2,900,000 feet B.M. of timber; 225,000 cubic yards of rock have been excavated. The engineers of the work were T. Pringle & Son, and W. McLea Walbank, of Montreal, and Dr. Cary T. Hutchison, New York City, had charge of the electrical department of the work. The contractors for excavation, masonry, and cribwork were Wm. Davis & Sons, Ottawa; for turbines, shafting, gears, etc., the Stillwell-Bierce & Smith-Vaile Company, Dayton, O.; for electric machinery, the Canadian General Electric Co., Peterboro, Ont., and for steel construction and pole line, the Dominion Bridge Company, Montreal.

Since commencing operations, the company has carried out extensive work for the improvement of the works. A certain amount of trouble was experienced through the backing up of water in the tail race in winter, caused by temporary blocking with ice, of the main channel in the river below. To overcome this difficulty, the wing-dam along head race has been raised three feet, and lengthened 1,100 feet, giving an additional 2 to 3 feet head. The tail race embankment has been raised 5 feet, and lengthened 1,700 feet. A clear channel in tail race, 5 feet in depth has been cut right out into the main channel of the river, and the excavated material used in the raising and extension of the

wing dams. The total length of the wing dam and tail race embankment, parallel to the course of the river, is now 7,700 feet. Owing to the increased head obtained, it is now possible to run the generators with five turbines. It will be remembered that each power house contains four generators, which were each driven by six turbines. The present operation of these by five turbines each leaves four spare turbines. Two of these are used to drive exciters, this doing away with the belted arrangement. The remaining two turbines, while still connected up with generator turbines, are arranged to drive heavy fire pumps, being thrown into service for this purpose by means of a friction clutch. Both the fire pumps and the exciters are located in the spaces over the waste weirs. The switch-boards are of marble and stand on the same floor level as the generators. Eight 750 K.W. generators are now in position, and the remaining four, will be installed during the next year. Power is generated at 4,400 volts, and



Interior View Power House.

transmitted at the same pressure to the distributing station in Montreal, a distance of six miles. The total power will be carried by 36 No. O copper wires, strung on double petticoated insulators on six cross arms. The poles are of lattice steel work, set 6 feet into concrete, and placed 100 feet apart. The distributing station is a substantial brick structure situated in the centre of the city. The distributing mains throughout the city are placed in underground conduits. The capital stock of the Lachine Rapids Hydraulic & Land Co., is $2,000,000.

The officers of the company are: G. B. Burland, president; Alex. Fraser, vice-president; R. Wilson Smith, W. McL. Wallbank, Peter Lyall, S. Carsley, E. K. Greene, directors.

W. McLea Wallbank is general manager, and R. S. Kelsch, superintendent. The head offices of the company are situated on Victoria Square, Montreal.

THE GOVERNMENT INSPECTION OF BOILERS.

The bill introduced into the Ontario Parliament at the instance of the Canadian Association of Stationery Engineers, entitled, "an Act for the protecton of life and property in the use of stationary boilers and engines, and the examination and licensing of persons in charge of them," the full text of which was given in the Canadian Engineer, September 1899, was again thrown out. The opposition of vested interests stood in the way of its passing, and the only substitute offered was an amendment to the Factory Act, which is little better than nothing. The amendment (Section 4, Cap. 35, Par. g), is worded as follows: "No boiler shall be used that is not insured in some boiler inspection company, duly authorized in the province for that purpose, or that has not been inspected within one year by a completent inspector, such inpector to be a man who has had charge of a boiler and engine for a period of not less than five years, or who holds a certificate as a stationary engineer, and the manager or proprietor shall, whenever so requested by the inspector, produce for examination the insurance policy or the certificate of inspection."

The flaws in the above amendment are obvious, and concern chiefly the inspector; for while five years' stoking and caring for an engine and boiler will give a certain amount of knowledge, it would not follow that a man would thereby obtain sufficient technical knowledge to qualify for an inspectorship. Five years, or even twenty years in a boiler room is no substitute for a qualifying examination, which would prove a man's fitness for the position. Even the possession of an engineer's certificate should not necessarily qualify a person for such a position, the incumbent of which should be a man of judgment, as well as good general knowledge. The absence of penalties of any description in the clause is a serious omission, for what is the use of enacting laws for the protection of life and property if the offender can violate them with impunity. The omission of a clause, requiring explosions of any kind to be notified to some government inspector, who can report on them, is an equally grave defect. So that as long as lives are not lost, and a coroner's jury not called in, boilers can merrily explode all over the country, and the government will be none the wiser as to the cause of explosions. In Great Britain, the supervision exercised by the Board of Trade, over the management of boilers, is a good model to copy, as it holds the owners responsible for all mishaps, under heavy penalties. There a man may use what sort of boiler or engine, or employ what class of engineer he likes; but if an explosion takes place, he is held responsible for damage to property or loss of life. This places the responsibility where it belongs.

WATER-POWER DEVELOPMENT AT CHAUDIERE FALLS, P.Q.

The Chaudiere River has its source in Lake Megantic, and flows in a northerly course to the St. Lawrence, where it empties six miles above Quebec. Two miles from the mouth are the Chaudiere Falls. The main fall is nearly 100 feet, but this is increased by a series of rapids both above and below the falls. At present there are nearing completion extensive engineering works which will make it possible to utilize all the power of the falls.

The writer is indebted to a report on this water power, by the late W. A. Ashe, C.E., for data regarding the discharge of the river. Mr. Ashe found the discharge to be 1,365 cubic feet per second at low water. In his report he advised using a head of 94 feet, which would give at least 9,500 effective horse-power. Assuming that in exceptionally low water the discharge might only reach one-half what it was when his measurements were taken, he decided that 4,750 net effective horse-power was the most that could be relied upon. By the use of a greater head and more efficient turbines it is expected that 6,000 horse-power can be developed. Although this water power is within nine miles of Quebec no attempt to thoroughly develop it has been made until now. The Canadian Electric Light Company bought out the water power and

secured control of the land on both banks of the river, above and below the falls. In September, 1899, work was commenced on the development.

By a brief description of the site an attempt will first be made to show the problem which confronted the engineers, and the general features of their solution. Above the falls the bed of the river is solid igneous rock, the strata running directly across the river, and dipping up-stream at an angle of 45°. Below the falls the water has worn a deep gorge out of the rock. This gorge, immediately below the falls, is divided into two parts by a high rocky ridge, which projects down it for about 250 yards. Except in very high flood all the water passed over the cliff to the east of this ridge, and out through the east gorge. The west gorge, is generally dry and is narrower, and on a higher level than the other. The main features of the plan followed are, the power-house, which is in the head of the westerly gorge; the penstocks running to a bulkhead which reaches across the head of this gorge, and prevents the water from flooding the power-house below, and the main dam which crosses the river above the falls.

The company has a contract to light the streets of Levis, and at first will confine its operations to the supplying of light and power on the south side of the St. Lawrence only. It is the intention to enlarge the power plant in the future, and to extend operations to the city of Quebec. Negotiations are in progress by which the company's wires will be carried across the new Quebec bridge. There will be a sub-station in Levis from which the transmission line runs directly to the power-house at the falls. At the time of writing the construction of the power-house had not been started, but it will be built at the head of what has been previously termed the "west gorge."

There will be installed a 2,000-h.p. generator, which will supply current to the transmission line at a voltage of 6,000, thus avoiding the use of "step-up" transformers. The generator will be run by a 2,400-h.p. turbine. Provision has been made for extending the power-house and adding two other units similar to the first. This will give a maximum capacity of 6,0000-h.p. The exciter will be supplied by its own turbine, and all turbines will have separate penstocks. The tail-race has been excavated from the wheel pits down to meet the river at the place where the two gorges unite. Most of the excavation for the tail-race, wheel-pits and the foundations of the power house has been through trap and light shale rock, but there was considerable drift boulders and gravel that had filled in the holes worn by the falling water, when the river had, years ago, run through this channel. The excavation for all four pen-stocks has been completed, but only two, the small one for the exciter and a large one for the first generator will be laid now. The pen-stocks consist of iron pipes, the larger one is 8 feet in diameter and 3/8-in. thick. They will rest on iron saddles, which will be anchored to concrete piers. The pen-stocks run up the hill at a steep angle, and then nearly level to the bulkhead.

The bulkhead is of concrete, and forms the lower end of the fore bay. Steel cones pierce the lower part of the bulkhead, and to these the pen-stocks are joined. They are supplied with manholes and valves for inspection, and drawing off the water. The cones are each provided with flanges, and a layer of mortar was placed between the concrete and the iron. The heads of the cones are 9 feet in diameter, and they narrow down to meet the penstocks. Air inlets are provided by iron tubes running vertically through the bulkhead from the top to the concrete arches at the head of the cones. The steel work was first put in place, and is anchored to the bulkhead by transverse channels buried in the concrete. The design of the head gates is worthy of particular attention. They each consist of two 3/4-in. iron plates, which are braced by horizontal I beams, which are further braced by vertical straps. At the bottom the gates rest on an I beam, and at the back they bear on two vertical I-bars. All joints are planed so that they will be perfectly tight. The total width of the gate is 9 feet 11 inches; the total height is 9 feet 5 inches, and of this the upper 2 feet 3 inches can be raised separately from the lower part on which it rests, this joint also being planed. This upper part is used as a filler. The whole gate is moved up and down between 18-inch channels by winches. The gates are further protected by stop logs, which fit between the outer pairs of vertical channels. The rack is made in sections, each section being hinged at the bottom and bearing against horizontal I-beams. The head gates and stop logs are raised from a platform along the top of the bulkhead. Through the east wing of the bulkhead is a scour pipe, which can be used to drain the fore-bay.

A wing dam of the same section as the main dam runs along the river side of the fore-bay from the bulkhead to the waste-weir abutment. The west or shore side of the fore-bay consists of an earth dam with concrete corewall. There is also a layer of puddle clay against the corewall. The bottom of this dam is strengthened by a masonry retaining wall from four to six feet high which prevents the washing away of the earth. This corewall is built into the bulkhead at one end and a winged abutment at the other, the abutment being filled with earth between the wings. From this abutment a timber crib, filled with stone, runs across the fore-bay, diagonally with the current, to the waste-weir abutment. From this same abutment at the shore end of the crib an earth dam with a concrete core-wall runs back over the flats for a distance of 320 feet, when higher ground is reached.

The timber crib is supposed to throw the ice off and protect the bulkhead during flood. With the wing dam it will tend to always leave still water standing against the head racks, and thus avoid trouble from frazil. The crib is made of square timber, and is 18 feet high and 20 feet wide. It is well packed with stone, and the upper face is covered with two layers of 3-inch planking. It is supported on concrete piers, which are placed parallel to the current. These piers are 34 feet 8 inches by 4 feet 8 inches, and are protected by an outer layer of 4-inch scantling, as is shown in the drawing. They are placed at 12 feet centres, and all the water entering the fore-bay passes between them, but arrangements have been made by which the openings can be closed by inserting stop-logs. By this means the water was kept from the bulkhead during construction.

The waste-weir is placed at the west end of the dam and just above the wing dam. It provides an unobstructed channel 12 feet wide. The crest of the weir is 9 feet 6 inches below the top of the dam. The inner pier of the weir, as will be seen from the drawings, is not carried up solid to the full height. The interior was well packed with stone, and then a foot of concrete was laid over the stone. The waste-weir is protected from ice by a floating timber boom, which follows the line of the upper face of the crib and bears against the end of the crib and the upper face of the east waste-weir pier. A slack chain from the centres of the boom is fastened to an anchor bolt in the west pier. This boom was added as a precaution against the ice that would be thrown from the end of the crib against the weir.

The main dam runs from the outer waste-weir pier straight across the river. The only protective works on the east side of the river is the abutment, the wings of which run into the high clay banks. The falls average about 160 feet below the line of the dam. The bed of the river consists of solid rock, except for a short distance in the centre. In all cases, all loose material was removed and the surface of the rock was well cleaned. The design called for longitudinal footings, and in addition, anchor bolts were used. They were grouted into holes that were drilled in three rows along the length of the dam. As a strata of much harder rock than the surrounding, projected along a great part of the bed of the dam, the excavations for the footings were governed accordingly.

Precautions were taken to make the dam as tight as possible. Two inches of cement mortar was spread over all the surface of the rock, and then the concrete was laid before the mortar had time to set.

The crest of the dam averages over 18 feet from the bottom of the river, and when the water reaches the top, there is a head of 110 feet under which the turbines are designed to work. The bulkhead and all protective works are carried 10 feet above the crest of the dam. The dam will back the water as far as the G.T.R. bridge, which crosses the Chaudiere three-fourths of a mile above the falls. The water stored in this reservoir is considered sufficient to supply the turbines at their utmost capacity for forty-eight hours.

The specifications for cement and concrete were very

stringent. Each lot of cement was tested when it was brought on the works, and if it did not come up to specifications, it was thrown out. Cases of dispute were referred to the Faculty of Applied Science of McGill University. Great difficulty was experienced by the contractors in procuring suitable sand. All sand was specified to pass through a 20-mesh seive, and be retained on a 30-mesh seive. No sand was found near the works that would answer this requirement, and the best would give 20 to 30 per cent. retained on the 30-mesh sieve. The stone for concrete was such as passed through a 2-inch ring, except that for a special finishing coat, which passed a one-inch ring. Both jaw and cone crushers were used, but the latter gave the better satisfaction. On the east side of the river a quarry was opened, which, with the addition of stone gathered along the bank, was used for work on that side of the river. On the other, the west side, from which most of the work was done, a quarry was opened and a tramway built to the crusher. This proved a very expensive method of obtaining stone, and it was shortly afterwards closed, and all stone was taken from the river. After the coffer-dam was built, a large reef of stone stretching across the river was exposed, and stone was quarried from this. The concrete was mixed by hand and machine. The latter were not used to their best advantage, and the product was no improvement in cost or in quality from hand mixed concrete. One mixer was placed in the fore-bay, and the concrete was fed into scale boxes on a tramway beneath the mixer. The boxes were rolled out when full and conveyed by derricks to the various forms where it was laid. Another mixer was mounted on a traveler for use on the main dam. This traveler straddled the dam and rolled along the leg on each side being above a rail. All the ingredients of the concrete had first to be raised to the top of this traveler by a derrick, and then fed to the mixer, which was on a lower deck. Difficulty was experienced before a satisfactory chute was made to lower the concrete from this mixer. Experience proved that a sheet-iron pipe eight inches in diameter, with a funnel mouth to swing below the mixer, was best. The chief fault with the mixer was that the product was not uniform, either in composition or wetness. This could probably have been avoided if arrangements had been made to feed the mixers continuously, instead of in batches.

The concrete in the core walls was a mixture of one of cement, two of sand, and five of stone. The bulk of the other work consisted of a 1, 2, and 4 mixture. A facing of 1, 2, and 3 was used in which the stone was screened through a one-inch mesh. This facing was used on parts exposed to the flowing water and ice. When this was used, all the interior was laid with a layer of 1, 2, and 4 concrete, and then immediately afterward the facing was put in and well rammed to take a hold on the other concrete while both were still moist. On the main dam this facing was not used, but the stone was as it came from the crusher with only the dust and the pieces larger than two inches screened out. Considerable experimenting was done to find how to get the best facing. Sometimes it was put in very wet and a mixture of 1, 2, and 3 was also used But experience seemed to show that it was a question of uniform mixing and hard ramming.

Large stones were buried in the concrete, but these had first to be bedded in mortar. When working on the main dam, great quantities of this stone were put in. Some of these stone contained as much as three yards. The stone was quarried from the rocky reef just above the line of the dam, and could be placed in position very cheaply, thus effecting a great saving to the contractors.

It was not until work on the main dam was started that any serious difficulty was experienced in unwatering the works. About one hundred yards above the crib, across the fore-bay, is a low, narrow island, seventy-five feet from the shore. A coffer-dam was built from the shore to the island, and another was built, from the outer side of the island, diagonally down stream to a ledge of rock which showed about two hundred feet above the middle of the concrete dam. These sections of the coffer-dam consisted of timber, cribs loaded with stone, and sheet piled on the upstream face. Earth was dumped against the piling until the dam was tight. Where the current was swift, small branches of trees were laid with the loose earth to bind it. The cribs consisted of the roughest of small logs held together by drift bolts. The water was not over five feet deep, and the crib was built forward from the shore. A flooring of round branches held the stone, which was wheeled out from shore and filled in as work progressed. This coffer-dam turned all the water to the east side of the river, and was sufficient to enable the west end of the main dam to be built. This section of the dam was not built up to the crest all along, but, after it had been laid all along the bottom, openings were left for the passage of water at a lower level than that of the crest.

From the point where the first part of the coffer-dam stopped in the centre of the river, another coffer-dam was built down stream to intersect the concrete dam, and a third section was built straight across the river to the east bank. At the time of writing only 150 feet of this last portion of the coffer-dam had been built. It consisted of seven crib piers with stop-log openings between. These cribs are ten feet by fifteen feet, and the openings are ten feet. Across the whole of the front is an apron made of plank nailed to a cribwork beneath. This is made tight by means of earth. The upstream faces of the piers are boarded and caulked to make them water tight. It was the intention of the contractors to build their coffer dam across the rest of the river similar to the first one described, only heavier, on account of the greater depth of water. Work would then be commenced on the concrete dam from the east shore and it would be carried out towards the workings from the other-shore. The water would then be kept from the final working by means of the stop-logs between the piers above, and by the wing dams to be built from each end of the row of piers to the completed parts of the concrete dam. Openings would be made in the other sections of the coffer dam, and the water would pass through the sluice-way and the openings that had been left for it in the concrete as the dam had been building.

Below the concrete portion of the dam a timber apron is to be built. At the time of writing the main dam is far from completion, but it is hoped that during the low water of the summer the dam will be rapidly extended across the river.

THE PACIFIC CABLE AND SIR SANDFORD FLEMING.

The purchase of a landing place for the Pacific cable on Barclay Sound, Vancouver Island, and the departure of an expert to choose the Australian terminus, marks an epoch in the realization of Sir Sandford Fleming's splendid work for the unification of all British colonies with the Mother Country by means of a cable which shall not touch foreign soil. On its completion Canada, New Zealand, Queensland, Victoria, New South Wales, India and South Africa will be in direct touch with each other and with England, without fear of intervention by any foreign power. This work in itself will entitle Sir Sandford Fleming to lasting honor as a patriotic and far-seeing statesman and engineer. While engaged in surveying a route for the Dominion transcontinental railway in 1871, and establishing a telegraph in connection therewith he became deeply impressed with the splendid possibilities of a Pacific cable, and its value towards uniting the colonies with the Motherland. In 1879 he submitted a plan, embodying this idea, to the Dominion and Imperial authorities. Projects, however, of this colossal size mature slowly, the difficulties in the way being enormous. The colonies were not in touch with each other, neither had they common interests. The spirit of Imperial unity was not yet mature, and such practical questions as ownership and proportionate cost tended to disintegrate rather than to bind. More definite and correct information as to route, ocean beds and costs were to be obtained and speedy progress was impossible. However, "labor (as typified by the invincible Gaelic nature of Sir Sandford Fleming) vincit omnia" the difficulties were overcome, and the various colonial governments, after many preliminaries, delays and postponements met at Ottawa in 1894 to arrive at some practical conclusion as to the feasibility and desirability of the cable. In August of the same year tenders were asked for laying and maintaining the cable. The apportioning of the cost to the various governments followed, and Canada's share of five-eighteenths will be her contribution towards cementing together the British Empire in closer bonds than

have been. The Pacific cable, which is to complete the British circle of the globe, will be about 8,272 nautical miles, viz., Vancouver to Fanning Island, 3,053; Fanning Island to Fiji (Suva), 2,181; Fiji (Suva) to Norfolk Island, 1,019; Norfolk Island to Queensland, 976; Queensland to New Zealand, 513.

The cable to be used is to be of the finest make, and will be manufactured under the immediate supervision of the well known engineering firm of Clark, Forbes & Taylor, 4 Great Winchester street, London, Eng. The various sections of the cable, according to position, are to have copper core, weighing from 130 to 600 lbs. per knot, and insulated with gutta percha, weighing from 130 to 340 lbs. for the same distance, the heavy shore ends being core-brass sheathed, and the heavy intermediate, light intermediate, heavy deep sea, and light deep sea sections, all being of the best type of manufacture. The contract for the cable is entered into by the Pacific

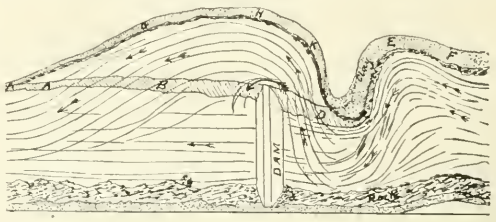
Cable Co. on behalf of the English Government and the Government of Canada, New South Wales, Victoria, New Zealand and Queensland, on the one part, and the Telegraph Construction and Maintenance Co., on the other part, who are represented by Taylor, Peake & Arthur in the name of the firm of Clark, Forbes & Taylor. The credit of bringing this gigantic scheme to a practical issue must undoubtedly be with Sir Sandford Fleming, whose experience, judgment and enthusiasm have been instrumental in fathering and furthering this splendid project. While famed in his adopted Canadian land, Sir Sandford Fleming is equally well known abroad, and honors have fallen thickly upon him. For many years Chancellor of the Queen's University, he has devoted much time to scientific research, and at various times published papers on "Cosmic Time," "Time Reckoning," "Selection of Prime Meridien to be common to all nations in connection with time reckoning." His works on this subject are quoted as authorities by European scientists. He wears the insignia of K.C. of St. Michael and St. George. Politically of no party, he is an ardent Imperialist, and is a councillor of the British Empire League. The realization of the Pacific cable will remain the greatest work of his life, and will undoubtedly, with his broad grasp of Imperial requirements, assist to place him in the front rank of colonial statesmen.

THE CHICOUTIMI DAM FAILURE.

BY CHARLES BAILLAIRGE, C.E., QUEBEC.

The recital of all such failures being interesting and instructive, not only to engineers, but to the general public, and to the writer himself who is always curious to know exactly how a thing happened; he left town for Chicoutimi (127 miles), by the Q & L. St J. Ry. on hearing of the accident to the big dam there last month.

The dam erected for the pulp works at Chicoutimi is at about a mile or more from the town. It is built across one of the discharges of Lake Kinogami, called the river Chicoutimi, emptying into the Saguenay. The stream is a powerful one, and on the occasion of the accident it had risen within the dam, so that its depth and head were more than 30 feet. As will be seen by the accompanying sketch, while the eastern bank of the river is composed of much rock and a slight earth or vegetable covering, the western side, on the contrary, shows little rock above normal flow level, with banks of clay and sand some 40 to 60 feet in depth. This bank before the occurrence was to be found at A B D on diagram, and is now to be seen some 300 feet westward of its former position or at A G H K on sketch.



What happened is this. The end C of dam not extending far enough into the bank, the bank and the ground around it, having been loosened to fit the dam to K, and the refilling not thoroughly rammed and consolidated at C, and under the action of the current which after being thrown by the bay D E F against the opposite side of the river, whence, like a billiard ball it was made to rebound towards C D, water under the great pressure of a 30-foot head was forced around end of dam at C, as shown by the curved arrow at that point. A tiny stream, at first of only a few inches, had very soon tunneled out for itself a large outlet into which the overlying soft and pliable superstructure of vegetable mould, clay and sand soon fell, leaving the gap open to the top of the natural embankment. The water now rushing through the continually increasing gap undermined the foot of the side hill or bank which was seen to slide down vertically into the river, and this action continued until as indicated by the arrows and the line A G H K, some 300,000 cubic yards of the cliff on the western side of the river had been carried away down stream, and the quondum crust of cliff at A B D removed to A G H K, or some 300 feet westward of its original position.

The bank between C and D should have been protected by rip-rap or a wooden revetement on crib work and extending up stream to F to stop the scouring tendency of the river; as was done at Grand Mere, where a similar bank of vegetable mould had to be cared for. The dam will now probably be extended across the gap to and into the bank at H, and the tongue of land D K left to wear itself away, until the river piles it up against C H, the dam extensions, to prevent the water going beyond H, and still further encroaching on the western hill, which, if it did, might cause the river to cut out a new channel in a position to threaten a portion of the city. But at any rate the superstructure of the dam, whatever the dam itself may be as a resisting medium, is of too flimsy a nature to stand the stress of water which may and has come against it. It is too narrow for its height and the duty it has to fulfil. It should have been fully 20 feet in width instead of 12, and all the gare timbers much heavier than they are, the whole being now out of line and out of plumb from the pressure of water.

The "instructiveness of failure" in this case is that the proprietors or company should listen to the suggestions of their engineers, and of men acquainted with the nature of the clay banks of the locality, and expend $10,000 or $20,000 in protecting them from scour, rather than, as in this case, run the risk of a failure which may probably be ten times that amount to the company.

P.S.—A word for the Q. & L. St. J. Ry. No one could realize on seeing me back to the city after an absence of only 36 hours (two nights and a day, and that day a Sunday), that I had actually got there and back at such a rate in a comfortable Pullman car. C. B.

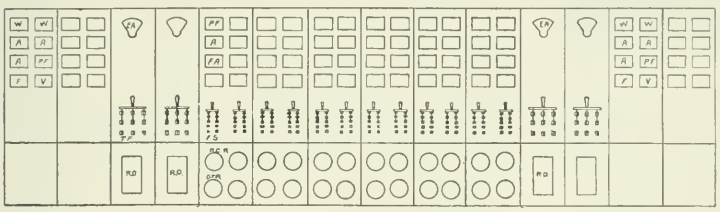
The North Shore and Manitoulin Railway Co. have called for tenders for a new section of their line from a point on the north channel of the Georgian Bay to the falls at the site of the Spanish River Pulp and Paper Co., a distance of about 16¼ miles.

A MODERN SWITCHBOARD EQUIPMENT.

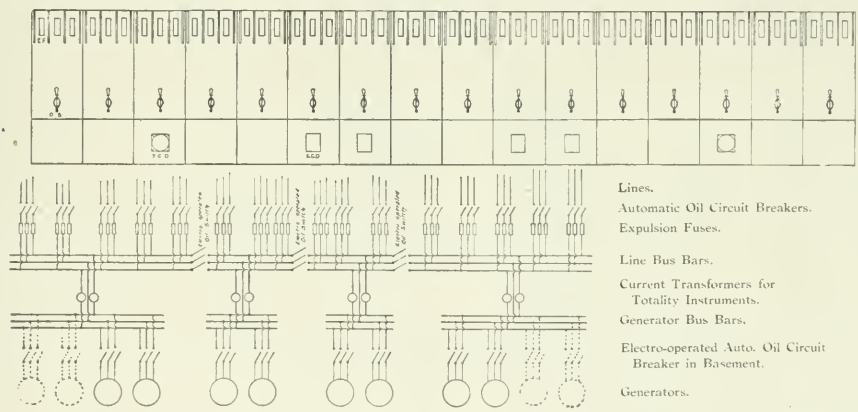
The following sketch shows the general arrangement of the new power-house switchboard of the Lachine Rapids Hydraulic and Land Co., whose power development is referred to in this issue: It will be seen from the section view that the cables from the generators pass under and through the basement floor to the large automatic controlled oil-switches. These switches are controlled from the operating table on the gallery above. From these switches the circuit continues on to the lower set of bus-bars, and from these bars, through tie-wires, in which are inserted the current transformers for operating the watt-meters, ammeters, frequency indicators, etc. From the upper bus-bars, connections are made to the line panels; each line being provided with an expulsion type fuse block and automatic oil-switches. The oil-switches open automatically at 50% overload. The fuse capacity is such that it will carry a 50% overload and blow at 60% overload.

a 10% reverse current. In the event of the four exciters working in multiple, and the water wheel of one exciter becomes defective, closing down the water-wheel, this exciter would be automatically cut off. The circuit breakers are so arranged that in the event of a very serious emergency, and it is desirable to shut down the entire plant, the four exciters could be disconnected from the exciter bus-bars by the switchboard attendant and from the operating table. The bus-bars are ⅜-in. by 2-in. copper bar, resting in glass insulators supported by malleable iron brackets bolted to the marble panels.

The cables from the generators pass through the floor and the lower current transformers to the three lower bus-bars. Below these bus-bars are located potential transformers for operating the various instruments. The three lower bus-bars are connected through current transformers to the three upper bus-bars by means of three cables. The current transformers on these cables are used to indicate the total amount of power passing from the lower bus-bars to the upper bus-bars. From



W.—Indicating Wattmeter.
A.—Ammeter, A.C.
V.—Voltmeter.
F.—Frequency Meter.
E.A.—D. C. Excite. Ammeter.
F.A.—D. C. Field Ammeter.
P.F.—Power Factor Indicator.
T.P.—T. P. D. T. Switch.
R.O.—Reverse Current and Overload Circuit Breaker.
F.S.—D. P. D. T. Carbon Break Field Switch
R.C.R.—A. C. Reverse Current Relay.
O.T.R.—A. C. Overload Time Limit Relay.
E.F.—Expulsion Fuse Block.
O.S.—Automatic Oil Circuit Breaker.
T.G.D.—Three Phase Ground Detector.
S.G.D.—Single Phase Ground Detector.



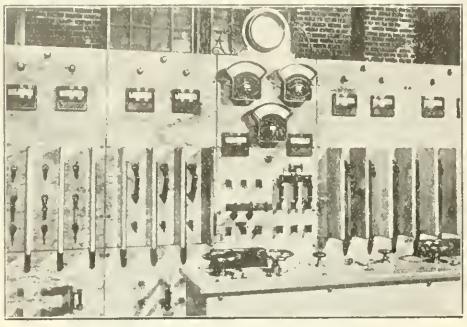
Lines.
Automatic Oil Circuit Breakers.
Expulsion Fuses.
Line Bus Bars.
Current Transformers for Totality Instruments.
Generator Bus Bars.
Electro-operated Auto. Oil Circuit Breaker in Basement.
Generators.

Power House Switch Board and Connections.

From the oil-switch, the line passes into the fire-proof sub-way, which runs the entire length of the power house. The sub-floor carrying the automatic controlled oil-switches is composed of I-beams, tile and concrete; the main floor carrying the line panels and bus-bar panels is composed of I-beams, concrete and Tennessee marble tiles 12-in. square. The gallery floor is supported by 3-in. I-beams, 18-in. apart carrying a sand-dressed Tennessee marble floor, the slabs being 18-in. by 36-in. This gallery contains the six generator panels, each panel having the instruments, switches, etc., for two generators. These panels are immediately in front of the operating table. The panels to the right and left contain the exciter switches, instruments, etc., also the instruments for recording the total output on the four separate bus bars, and is so arranged that the operator standing before the operating table can see all of the instruments, which will be but a short distance from him, and from the operating table he has full control of the motor driven rheostats, the oil switches on the generators, the water-wheel governors, the circuit breakers on the exciters, etc. In fact, it is intended that one man shall operate the whole plant, which is housed in a building 1,000 feet long, containing three dynamo houses located 300 feet apart. The exciters are provided with circuit breakers which open automatically at 100% overload, or open automatically on the upper bus-bars cables are run to each of the thirteen (13) line panels. Each panel contains A. C. ammeters, wattmeters, power factor indicators, voltmeters, frequency indicators and synchronizing instruments. Also the reverse current circuit breakers for the exciters, and reverse current relays for automatically operating the oil-switches—including the field switches for the generators, main three-pole switches for the exciters, together with ammeter, voltmeter, etc. The line panels consist of a complete panel for each line—each panel containing three 5,000 volt, 150 ampere expulsion type fuse blocks, separated by barriers, and one three-pole 5,000-volt 200-ampere automatic oil-switch. The arrangement of bus-bars entirely meets the needs of this plant. The 12 generators are connected to four separate bus-bars, and the lines are equally divided between four separate bus-bars of equal size.

The generator bus-bars are connected to the line bus-bars through current transformers which operate instruments indicating the total output or power passing from the generator bus-bars to the line bus-bars. This company intends operating its power service separately from the lighting service. By this bus-bar arrangement four, six or eight generators can be operated on one system with four operating on the other system—one for power and one for light. A system of switches is so arranged that the entire system can be tied together and run

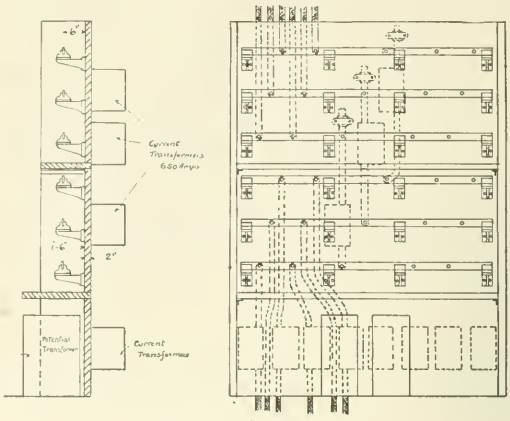
as one system, or, in the event of an accident to any portion of the system, it can be quickly separated from the rest of the system until repairs are completed. The arrangement is such that during light loads, or Sunday, etc., any portion of the plant can be made dead throughout, permitting any slight repairs that may be necessary, and a general and thorough



Power House Switch Board.

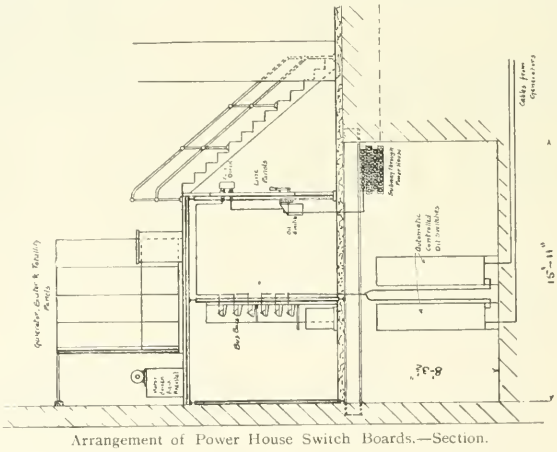
cleaning up of the bus-bars, marble, etc., without the slightest chance of injury to an employee. The arrangement also permits running one or two generators on one or two lines, in the

clusive of any double throw switches on the high tension portion of the station, the use of which this company does not consider safe for such a large installation. All of the switch-

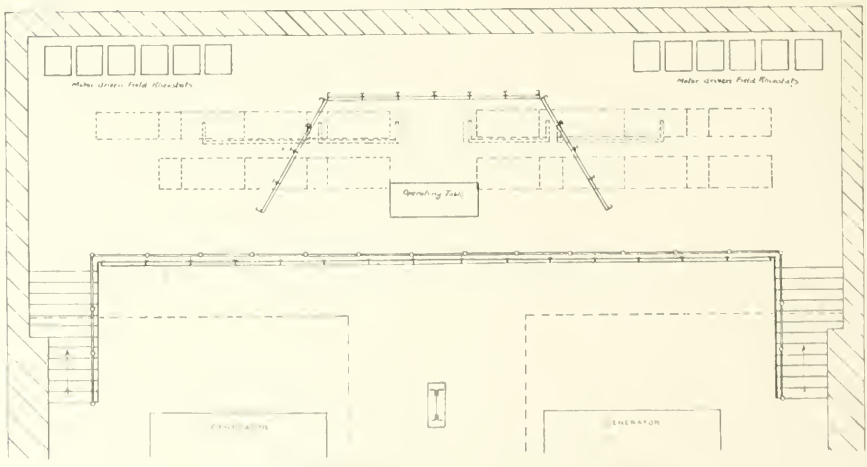


Bus-bar Panel for Power House.

ing devices used in connection with this board have indicating signals, consisting of a colored bulls-eye, 1½-in. in diameter. There are two for each switching device, one red and one



Arrangement of Power House Switch Boards.—Section.



Arrangement of Power House Switch Boards.—Plan.

event of this company securing a contract for power which might be objectionable to tie up to the system in general. It will be noticed that the arrangement is very flexible, yet it is

green. If the switch is closed the red bulls eye is lighted, and when the switch is open the red is extinguished and the green bulls eye lighted. As is shown on the section view of the

switchboard, gallery, etc., all of the high tension wiring and apparatus is on the sub-floor and main floor, and none of the low tension wiring or apparatus is on this floor except the leads from the transformers. On the gallery where the operator is stationed, there will be absolutely no high tension wiring or apparatus of any description. All current transformers, potential transformers, etc., will have their cases and secondary wiring grounded so that it will be impossible for the switchboard operator to be injured on the gallery floor, and also impossible for anyone to be injured on the high tension floor, as that portion upon which it is necessary to work can always be made dead and absolutely safe.

The new city sub-station plans are not quite completed, and it is impossible at the present writing to show what the new sub-station will look like. The main switchboard for distributing from the sub-station, however, has been designed, and is about completed. This switchboard consists at the present time of 20 panels; 18 feeder panels, and 2 total panels. Each feeder panel consists of one oil-switch, three ammeters, three expulsion type fuse blocks and six plugs, permitting the connection of any line to either set of bus-bars. This can be accomplished without cutting off the circuit by simply connecting the two sets of bus-bars together at a main switch provided for the purpose, it being necessary, of course, to get the bus-bars in synchronism before closing the switch. Each total output panel contains two indicating wattmeters, one frequency indicator, three ammeters, three voltmeters, and one voltmeter with a scale 90 to 130, having large unit divisions. This voltmeter can be switched on to any of the return pressure wires used to determine the pressure at a given point on any line. Immediately below are the small switches for operating the induction regulators by means of a small induction motor. These regulators are for the purpose of maintaining the necessary pressure on each and every line, depending upon the load upon the line. It can be readily seen that this would be necessary as it would be impossible to give good service from a station whose load consists of the business districts in the early part of the dark days which rapidly decreases about 6 p.m., and increases with equal rapidity on the other lines supplying the suburban districts, at about the same time. On the sub-panels of the total output panels are located three-phase ground detectors. The six bus-bars run the entire length of the board, with arrangements for cutting these bus-bars in the rear of the total panels. It is the intention to run both sets of bus-bars in multiple, so long as the character of the load is sufficiently steady, and does not interfere with the company giving an A No. 1 lighting service. In the event of the motor service interfering with the lighting service the bus-bars will be separated; one set carrying the purely power circuits and the other carrying the lighting, and also circuits having a mixed load of lighting and light power customers. These two bus-bars can be separated at about the centre, and so arranged that they will practically have four (4) distinct sets of bus-bars, enabling the distribution of the load on the water power or reserve steam plants, as occasion may require. It will also enable the company to make dead either system during the hours of light load, Sundays, etc., to permit of any slight repairs, cleaning, etc. From the bus-bars connection is made to one end of the plug switch; through the plug switch to the upper terminal of the fuse block; through the fuse block to the current transformers which operate the ammeters, and from the current transformer to the oil switch, passing through the oil-switch to the cable head below, and from this point through the cable into the underground subway. The line panels contain three ammeters, and immediately below them, three single-pole knife switches. These knife switches short circuit the two terminals immediately below each switch, and are for the purpose of permitting the connection of a recording or indicating wattmeter, one on each phase, by means of which a record can be taken from any circuit of any kind, for 24 hours or longer as desired, showing the power factor of the load, etc. By means of these switches and terminals the ammeters can be calibrated without disconnecting them from the board, and in fact without interfering with the instruments in any way whatever. The wattmeters for making these tests will be mounted on a portable desk, which can be placed immediately in front of the particular panel operating the line to be tested. The Lachine Rapids Co. design and construct all of their switchboard work in their own shops

MAGNETIC IRON SAND OF THE ST. LAWRENCE SHORE*.

BY J. OBALSKI, M.E., QUEBEC.

Those deposits have always been known, and forty years ago they called largely the attention of business men as being a source of iron ore of the best quality and of the highest grade. In 1867, a company called the "Moisic Iron Co." was organized in Montreal; the president was W. M. Molson, and amongst the directors there were the Hon. L. Letellier, Hon. R. Laflamme and L. Labreche Viger, M.P. This company bought large tracts of land in the vicinity of Moisic, built on the spot eight bloomary furnaces, using the magnetic sand as ore, and charcoal as fuel. The product of these furnaces was sent to the United States, or used in Montreal at a rolling mill controlled by the company. Nevertheless, the chief market was in the States, where the product of the furnaces was shipped, submitted to the duty of pig iron, say $7 per ton. In March, 1875, under the protest of the American iron workers, it was declared subject to the duty on bar iron, say 1½ cents per lb., or $34.80 per ton, which compelled the company to shut down the work, and to go into liquidation, owing to the absence at that time of a sufficient Canadian market. In August, 1868, when Dr. Sterry Hunt visited Moisic, out of the eight furnaces built, there were four in operation, giving a total of three tons of iron for 24 hours with 12 men, using 1,400 bushels of charcoal, say 466 bushels per ton of iron. The concentration of the ore was then made by Dr. H. Larue's process, consisting in magnets under which an endless table passes with the sand on it. The magnetic portion was attracted, but there was a fine clothing under the magnet, and by moving it down, the iron sand was put loose and dropped in an adapted receiver. It is said that one ton of pure ore was obtained, out of 2 or 3 of sand per day for each machine. Several processes have since then been suggested for agglomerating the magnetic sand, and in the elaborated report of Dr. T. Sterry Hunt, published in 1866-1869, vol. of the Geological Survey, and in which I have largely taken information for this paper, I remark the name of R. G. Leckie as the patentee of a process for using that sand properly reduced in connection with the manufacturing of steel by the Martin-Semmens process. Labrecque Viger was also the inventor of a process to manufacture directly steel from that ore. But since the abandonment of this industry, no other attempt has been made, and that immense quantity of iron ore is still there, waiting for the skill and energy of some enterprising concern to be utilized. A company, called "The Natashquan Magnetic Iron Co." shipped from that place some quantity to England, for trial. I heard that the ore was successfully smelted then, but no practical result was obtained, probably on account of the difficulty of shipment. Dr. Sterry Hunt analyzed these sands and reported on them in 1866-9. The black sand contains grains of quartz, garnets, and other hard minerals, besides quantities of magnetic and titanic iron. No trace of gold was found, although it is claimed that there is some. The analysis of Moisic, Betsiamits, and Mingan sands showed 55 to 67 per cent. of metallic iron with an average of 1 per cent. of manganese. An analysis of Moisic pure sand, by Professor Stillman, of Stevens Institute, Hoboken, N.J., showed oxide of iron, 96.67; phosphorous, .63; sulphur, traces; manganese, .33; titanium, .00; insoluble matter (silicate of alumina), 2.88; undetermined, .00; total, 100. Equivalent to 70.01 of metallic iron.

Those analyses made recently have been communicated by R. T. Hopper, of Montreal, from concentrated ore obtained with a special machine of which he has the control. They show that he practically got rid of the titanium. Mr. Hopper has made important prospects and experiments on the black sand, specially on the ore of Natashquan. By 1865, there were many applications for land on the coast, and the Quebec Government had a few townships partly surveyed, and many lots sold for mining purposes. Since that time, there was nothing done but for a couple of years, some prospects have been made, and we have received many enquiries regarding the black sand. Eighteen months ago, I made a personal visit to the coast, from Sheldrake to Natashquan, with the result that I was very favorably impressed by the magnitude of those deposits. It must be remarked that the sand does not occur all along the coast but only in several places, the most important being Natashquan

* A paper read before the Canadian Mining Institute.

Moisic and St. Jean. I have not visited the Moisic deposit, but from several reports I have in hand, I understand that the quantity of black sand is large, and extends for quite a distance east of Moisic river. The nearest harbor is the Seven Islands bay, 16 miles from Moisic. I give below my impression on the deposit I personally visited. The beach sand has been produced by the disaggregation of ferruginous rocks of the Laurentian formation, including anorthosites, against which the sea has broken during geological periods of indetermined length, and the matter so produced has been subjected to a natural concentration slightly different from that which occurs in an ordinary stream. The waves lift both the heavy and the light elements, but when they recede, they carry away chiefly the light elements, leaving the heavy ones on the beach; this operation repeated a great many times, causes deposits of greater or less thickness according to the strength of the waves. The wind also produces its effect by covering up the heavy deposits with layers of lighter sand. All these facts may be ascertained when a hole is dug in the beach, and the different layers of varying thicknesses and with varying percentages of metal are examined. Nevertheless, these deposits are chiefly observed about the low points, denuded of rocks, and their number is limited. It is very probable that the sea level has been lowered, and that, as the same phenomena occurred formerly, similar deposits may be found in the low-lying spots at a certain distance from the present sea-shore. This fact seems to have been ascertained by explorers and surveyors, and in the reports of the Department of Crown Lands and of Mines for 1899, a few facts are recorded regarding this point.

Dock Bay.—Immediately above the fishing station known as "Dock Bay," between Thunder and Jupitagan rivers, a little black sand is found in the bay, on a length of 500 feet and a width of 30 feet. On a point where the shore has been eaten away by the sea, there is a thickness of 10 inches surmounted by 5 inches of yellow ochre.

St. John River.—This deposit extends from the mouth of that river for a distance of 6 miles to the northeast, but the greatest development is in sight at Pointe Noire, 4 miles from the river St. John. The black sand is visible on the surface in beds more or less rich, with a thickness varying from 2 or 3 inches to 10 inches. I measured the beach from low water mark to 100 and 300 feet where there is an intricate growth of small spruce trees making it difficult to see anything; but this soil may also contain ore. The river St. John can be entered only at high water and by small schooners. From Pointe Noire to Mingan river, the shore is flat and the sand is also mixed with black sand. I did not find a great abundance of it, but as the action of the sea alters the look of those beaches, according as the black sand is more or less on the surface, it is possible that there may be enough to work at or at least that by prospecting a little inland, it may be found in greater quantities. The nearest deep water harbor is Mingan, but the river St. John could be used for loading small schooners or barges which could be towed to Mingan (12 miles) for supplying large vessels. Continuing along the coast, I found but little black sand, the shore being generally rocky. At Esquimaux Point, the beach is sandy, but I did not find it in workable quantities.

Great Natashquan River.—From the mouth of the river towards the east, for a distance estimated at 20 miles, there is in sight between the low water mark and the timbered ground, a stripe of sand formed by the flat beach from 100 to 400 feet wide, and of dunes ranging from 5 to 50 feet in height, and extending backwards 600 feet from low water mark. The black sand is distributed all through that area in alternate layers of varying thickness, going from 1 inch to 2 feet with a practical yield of black sand from 20 to 05 per cent. I have measured sections of the dunes which for 15 and 20 feet in height would give from 40 to 60 per cent. of black sand as an average. It can be seen also on the East shore of the Natashquan river itself. It is said that it continues as far as Kaghaska river, and is found in this bay and the Musquarro. The average proportion of black sand may be considered as 40 per cent., the quantity of pure magnetic iron being 25 per cent., containing from 68 to 70 per cent of magnetic iron. I well remember that the theoretical yield of this ore is 71.78 per cent. Now, if we take an average depth of 20 feet, a width of 600 feet only, we will have, for each mile, over 1,500,000 tons of pure ore of 68 to 70 per cent of iron, taking 300 lbs. as the weight of a cubic foot of such ore. The tonnage is considerably larger, as we take only 600 feet of beach to the line of trees. This beach, as well as the others I have seen, is exposed to the sea, and there is no harbor in the immediate vicinity, the nearest being that of Little Natashquan, 4 miles to the west of Great Natashquan. This harbor is well protected, and could easily be made accessible to vessels of heavy burthen, It is surrounded by granitic hills and protected towards the sea by islets of the same rock. On the Great Natashquan, 12 miles from the sea, is the first fall, 30 or 40 feet high, which could supply the motive power for large mills, and it is followed by three other falls separated by intervals of from two to three miles. According to the above, the beach deposits are generally in sight for several miles on low shores exposed to the open sea and without harbors or shelter. Large vessels loading ore there would have to anchor at a rather considerable distance from the shore, and special flat-bottomed lighters of somewhat small dimensions would be required to convey the ore in sacks to the large vessels which would hardly be practicable. In the two principal instances where I made an inspection, I consider that it would be completely impracticable to ship the ore direct by sea from the spot whence it would be obtained. It would thus be necessary to seek for the nearest harbors, to have the sand concentrated and purified on the spot and the merchantable product conveyed by tramways to the point of shipment. It will therefore be seen that the working of these deposits must be done on a large scale, and that it would require considerable capital for the manipulation of large quantities by mechanical process and for purifying and conveying the product to suitable harbors. The working of the sand should be done by means of steam shovels feeding cylindrical driers, whence the ore would be taken to electro-magnetic separators, several systems whereof have been patented. When separated, the magnetic oxide would be loaded in small cars which, by means of tramways would convey the ore to the wharf where it would at once be loaded on the vessels or be kept in elevators. The motive power could be supplied by the water-power in these regions, and the fuel would consist of fire-wood cut in the neighborhood, or of Nova Scotia coal which could be landed there for $3 a ton at the most. The season of working would extend from May to October, say six months.

Sufficient ordinary labor could be obtained there cheap, and moreover, the manipulation of the sand should, as far as possible, be effected by mechanical means. As for the use of that ore, I think that the iron and steel works at Sydney, C.B., could use part of it as a mixture, the distance from the deposit to Sydney harbor being between 300 and 400 miles, and the coaling steamers returning from Quebec could take it as a backward freight to Nova Scotia. The distance from Natashquan to Quebec is about 500 miles, and from Moisic, 300. The three principal deposits on the north shore are in the vicinity and to the east of the Moisic, St. John and Great Natashquan rivers, but there are also less important ones at Portneuf, at Jeremie Bay (west of Betsiamis river), at Manitou River, at Dock Bay and in the bays of Kaghaska and Musquarro. It is also reported there are thin layers of black sand on the northwest arm of St. Augstin river for a distance of 30 miles.

Mr. Quin, the borough electrical engineer of Blackpool, England, has perfected an invention of considerable importance, by which all dangers from overhead electric wires are obviated. When a wire breaks the current is automatically switched off and the wire rendered harmless. The automatic switch has been tested with success.

—The Warren Company, of Chicago, manufacturers of Warren's pulley cover and other mill supplies, has removed from its former office at the corner of Jackson boulevard and Wabash avenue, to much larger quarters at the corner of North Franklin and Chestnut streets. This change was necessitated by the growth of its business which requires more office and storage space. In mills, factories and electrical plants where strict attention is paid to the details of the purchase and use of supplies, and where the more progressive superintendents and engineers are employed, the pulley cover made by this company meets with the best sales. Letters received from these men show that many of them consider Warren's pulley cover more desirable and economical than any dressing applied to the belt, some of which injure the belt besides requiring frequent application, while this pulley cover does not have to be removed for months, sometimes years.

Industrial Notes.

The Waterloo Mnfg. Co., Waterloo, have placed their order with the Smart-Eby Machine Co., for a 5-ton travelling crane.

The chimney, 107 feet high, of Jewett's sawmill at Milledgeville, N.B., has collapsed, crushing three men to death and injuring three others.

The London Engine & Supplies Co., London, have placed their order with the Smart-Eby Machine Co. for one of their high-speed vertical engines for electric light work.

Nearly 200 men are engaged at the construction work of the Nova Scotia Steel Co.'s coke ovens, Sydney, N.B. The ovens will be in full blast, it is expected, this fall.

The New Process Raw Hide Co., Syracuse, N.Y., recently shipped one of its new process noiseless pinions to Germany to be used on the private yacht of Kaiser Wilhelm.

Stutt & Sons, of West Flamboro', have recently placed their order with the Smart-Eby Machine Co., of Hamilton, for a number of dryers and a set of calender rolls.

W. J. McKay, of Orangeville, Ont., has signed a contract to establish a pork-packing establishment in Brockville, Ont., which will be called the St. Lawrence Packing Co., of Brockville, Ltd.

The Kinleith Paper Co., of St. Catharines, have recently installed one of the Smart-Eby Machine Co.'s automatic feed pumps and receiver, for returning the condensation from their paper machine to the boilers.

L. R. deMartigny and J. L. Degrau, of Montreal, are seeking inducements to build a rubber factory at Granby, Que. They ask a bonus of $25,000, and propose to employ 100 hands and pay $37,000 in wages yearly.

A shocking tragedy occurred at Senator Snowball's mill, Chatham, N.B. A young man named Cuthrow was feeding the furnace, and when the mill shut down he was missing. The furnace was searched and human remains were found.

The Canadian Steam Fire Engine Company (who acquired the plant of J. D. Ronald, Brussels, Ont.), have purchased a site for their new factory in London, Ont. It will be a two-storey brick building, 56 x 80 feet.

The Detroit Wire Fence Co. are contemplating the establishment of a Canadian branch of their works at Peterboro'. The company propose to spend $35,000 in buildings, and engage about 40 hands. The town is anxious to secure the new works and a site has been offered.

The Frost & Wood Co., of Smith's Falls, and the Coulthard, Scott Co., of Oshawa, agricultural implement makers of Ontario, have consolidated. The first named company assumes possession of the Oshawa Company, which will be developed extensively. A third company may also be taken in.

The manufacturers of agricultural implements have organized a section of the Canadian Manufacturers' Association. They elected the following officers: Chairman, J. Maxwell; vice-chairman, H. Horsman; executive committee, H. Cockshutt, W. F. Johnston, W. E. H. Massey, H. P. Cockburn.

St. Thomas, Ont., may be chosen as the location of the Wabash Canadian Railway shops, which President Ramsay says will cost $100,000 to build, $40,000 to equip, and employ 150 hands. The town council are naturally favorable to the proposition, and have appointed a special committee to deal with the matter.

Henry Eberling, managing director of the Welding Compound Company, of Paterson, N.J., is looking for suitable premises in Hamilton, Ont., for the purpose of manufacturing. The company has a great many customers in Canada, ships extensively to Australia, and is anxious to open a branch factory here.

The Northey Manufacturing Company, of Toronto, is building the largest electrical single pumping engine in Canada for the Montreal Water Power Company. The price is $27,000. It is 40 feet long, 20 feet wide, weighs 200 tons and one of the gear wheels is 30 feet in diameter. It will throw a column of water 400 feet high.

The Record Foundry and Machine Co., Moncton, N.B., are extending their works.

Owen Sound, Ont. has passed a bylaw to raise $30,000 for extending the waterworks system.

The recently burnt Board of Trade building, Montreal, is to be rebuilt on the old site.

The Dominion Organ & Piano Co., Bowmanville, is about to build an addition, 40 x 160 feet, to its plant.

The second furnace of the Dominion Iron and Steel Co., Sydney, C.B., was blown in on May 12th.

The Mason Regulator Co. have removed their offices from 68 Oliver street to 158 Summer street, Boston.

The Robb Engineering Co. are supplying a new steam plant for the Standard Mnfg. Co., of Sackville, N.S.

Magog, Que., will purchase a steam fire engine from the Waterous Co., Brantford, and a chemical engine from the Champion Fire Extinguisher Co., Chicago.

W. J. Hill, M.P.P., has received the contract to build four immense iron-smelting furnaces at the "Soo" for the Clergue syndicate. This contract involves nearly $500,000.

The strike at the Kingston Locomotive Works has been settled by concessions to the men, but the company is seriously considering a proposition to move the works to Quebec.

The J. D. Shier Lumber Co., Ltd., has been incorporated; capital, $100,000; office at Bracebridge, Ont. Directors, J. D. Shier, W. H. Shier, J. H. Menzies, E. A. Begg and W. T. Gwyn.

The Lake Huron Lumber Co., Ltd.; capital, $40,000; office at Spanish River, Ont., with H. W. McCormick, C. F. Braman, C. McCormick, J. M. Braman and F. D. McCormick as directors, has been formed.

Fraserville, Que., has granted a bonus of $5,000 to M. Laurin to establish a furniture factory in that town. He will employ from 40 to 60 men, and must have $40,000 capital before commencing.

The work of building the Collingwood plant of the Cramp Ontario Steel Co. is to commence at once. F. H. Clergue, of Sault Ste Marie, has resigned his seat on the board, owing to some conditions on which he joined, not being fulfilled.

The Canada Foundry Company, Toronto, has bought out the Toronto Fence and Ornamental Iron Works Company, and will carry it on as a branch of the large new works now being erected at the corner of Davenport road and Mackenzie avenue.

The Dominion Iron and Steel Company have decided to erect two more blast furnaces in Sydney. Work will be commenced shortly and the furnaces will be completed within eighteen months. The third furnace will be blown in this month.

A local financier is laying before the Kingston city council a proposal to take up the agreement entered into with Meyer Bros., relative to the establishment there of a smelter. The proposed company would carry out the bargain which the Meyer Bros. were unable to fulfil.

The population of Depot Harbor, Ont., the terminus of the O. A. & P. S. railway, is already about 1,200, and 26 new houses are under construction. About 20,000,000 bushels of grain will be shipped there this year. The port was opened only four years ago.

A deal of importance has been completed by the consolidation of all the Canadian salt interests in a trust, whose capital is $8,000,000. The price paid to the Windsor Salt Company is said to be $800,000 cash. The headquarters of the new trust will be removed to Montreal. Sir Wm. Van Horne is a member of the new syndicate.

J. L. Board, of Chicago, and his associate, W. Cummings, have organized a company capitalized at $600,000, and will establish a plant at Point Edward, Stratford, Ont., for the manufacture of machinery for making tin goods. They recently conducted a similar business in Chicago, but sold out to the American Tin Company the rights for the United States. The Grand Trunk Railway Company have given them the lease of the old round-house at the Point, and a new building will be put up at once.

Plans for the new library and convocation hall to be built by the executors of the late H. A. Massey, and the new physical and biological laboratory to be built by the Government for the Ontario Agricultural College at Guelph, have been prepared. Tenders will soon be called for and the buildings are to be completed by October 1.

Three men, named F. Eaton and T. Bowser, of Elizabeth Bay, and T. Gaffney, of Mount Forest, were killed by a boiler explosion in J. H. McMillan's mill at Elizabeth Bay, Ont. The cause is not reported.

The Canadian Steam Carriage Co. is a concern that has been incorporated with intended factory at London, to be ready for work about July 1st, with fifty men. The officers are: President, J. Curry, Toronto; vice-president, J. M. Staebler, Berlin; secretary, E. H. Hilborn, Toronto; treasurer, M. Rumball, London. The company purposes to make a full range of automobiles.

It is rumored that the Canadian Smelting Works of Trail, B.C., now the largest producers of lead bullion in Canada, will proceed immediately with the construction of a lead refinery either at Kootenay or at some point on the Atlantic seaboard. There is also some talk of Canadian capital being raised for the purpose of erecting white lead works in the East.

The Canada Motors, Ltd., Toronto, is a company backed by English capital, and hitherto the output has gone chiefly to England. Mr. Thompson, manager of the company, stated that they had orders booked ahead beyond the capacity of their works, and they expect in the near future to make large additions to their plant, which manufactures electric motors under the Still patents described in this journal.

The Imperial authorities have decided to erect a new brick barracks, officers quarters, etc., and to construct other important works in Halifax, N.S., this summer. The military have also in view the construction of a fort that will exceed in proportions York Redoubt, which is second only to the one at Gibraltar. The new fortress will be filled with twelve inch disappearing quick firing guns of the very latest type. It is stated that the new fort will be located at or near Sambro, and will be far superior in armament and extent to any fortress in America and second to none in the world.

Mining Matters.

The Westmoreland Copper Co., of Dorchester, N.B., is erecting a complete electrolytic plant for treating copper.

The Rossland, B.C., Great Western Mining Co. have installed a forty drill electrical compressor, which is working well.

The recent boring for oil in Gloucester township, Carleton county, Ont., resulted in the flow of natural gas of 200 pounds to the square inch.

J. W. Boyd, of Denver, acting for Boston capitalists, has bought the Pritch & Trembley copper deposit on Black Bay, Lake Superior, for $100,000.

The Cariboo mines, Nova Scotia, are to be fitted with a 100-ton cyanide plant, which is being built at Truro foundry, for the extraction of gold from tailings.

Prof. Frasch, who joined the board of directors of the Hamilton Nickel Copper Co., as reported in our last month's issue, has been appointed managing director of that company.

Malachite, a very rare mineral in Canada, but which is found in Russia in large quantities, has been discovered in North Hastings. It is a carbonate of copper, of a green color.

D. F. Burk reports the finding of rich mica deposits on the Canadian Northern Railway 140 miles west of Port Arthur. A block 6 feet cubed, is to be sent to the Pan-American Exhibition, as the largest piece ever discovered.

The Marbou coal mines, between Port Hood and Broad Cove, C.B., have been sold for $200,000, to C. Lionais, on behalf of Canadian and American capitalists, who are also contemplating the purchase of the Burchell mine in the same locality. A pier will be erected at Marbou.

G. E. Wood, of lot 4, con. 7, Gosfield North, Essex Co., Ont., while boring an artesian well, brought up yellow borings, which on being tested at the assay office were pronounced to be pure gold. A local company has been formed to develop the find.

It is reported that a three and a half foot seam of coal has been struck by the men at work at G. R. Jones' coal mine at Harcourt, N.B. The mine has recently been bonded by Mr. Jones for $25,000 to Americans, and it is the intention to extend operations.

A New Brunswick charter has been granted to the Canadian Coal & Manganese Co., Ltd. capital, $1,000,000; office at Coal Branch, N.B. C. G. Polleys, G. R. Jones, A. Gibson, E. A. Reilly, J. P. Gaddes and J. H. Rogers; to acquire and operate the coal mines at Mount Carlyle, Kent county.

It is announced that Dr. L. Mond's copper and nickel interests in Wales and Sudbury, Ontario, have been sold to an English Company with a capital of £600,000. Hon. G. A. Drummond and J. Ross, of Montreal, are directors of the new company, which will extend operations at the mines.

The United Gas & Oil Co., of Windsor, Ont., has struck a high pressure gas well in Gosfield South. No test has as yet been made of the pressure or volume of the gas, but it is believed the well is the equal of the one recently struck at Leamington, which has a pressure of 140 pounds.

Prospectors in Brummell, Muskoka, Ont., who are using one of the Ontario Government's diamond drills, have found a vein, eight feet in width, of copper and iron pyrites. It is thought there is also nickel in the ore, and the find is looked upon as a valuable one.

Extensive deposits of talc are said to have been found near Mora Lake, North Hastings, Ont. Talc, essential to a certain high-grade finish on commercial and printing papers, is indigenous to the Laurentian formation and is now practically found for the first time in an accessible section of Ontario.

J. C. O'Hara, the well-known explorer, has gone to Winnipeg to close a deal for 16,000 acres of timber lands north of the Winnipeg country, and the deal includes an immense find of coal made by him while exploring for spruce. Duluth parties are interested.

The following appointments have been made to the Kingston School of Mining: Prof. Dupuis, professor of mechanics; Prof. Gill, acting professor of electrical and mechanical engineering; Prof. Marshall will look after the mathematical physics, and N. R. Carmichael will be assistant professor of experimental and applied physics.

A large mining deal was consummated in Victoria, B.C., when two groups of claims on Mount Sycker or Sicker were sold to a New York syndicate. The purchase amounted to $336,000, one-quarter of which is cash. The purchasers were represented by W. A. Dyer of Victoria, B.C., and E. E. Smith, of New York.

The Granby Mining and Smelter Co., Grand Forks, B.C., have recently ordered a second complete copper smelting and converting plant from the Gates Iron Works, Chicago. The results of the first order were most satisfactory, and from 500 to 600 tons of ore were treated per day. When the new plant is installed it is expected that 1,200 tons will be treated daily.

Important deposits of manganese ore of good grade have been discovered in the islands of the Madelaine group, in the Gulf of St. Lawrence. The fact was known a long time ago, but a prospect made last summer has shown a considerable extent of this ore. The mining right is under the control of W. G. Tait, from Pictou, N.S. This discovery is an important one at a time the metallurgical industry is taking such a development in this country.

The Ontario Bureau of Mines, recognizing the importance of placing elementary scientific knowledge within the reach of those living in the mineral regions, announces that summer mining classes will be held at Deloro and Cordova, in the gold regions of Hastings; Combermere in Renfrew; Copper Cliff, Bruce Mines, Rock Lake, Victoria Mine, Gertrude Mine, Helen Iron Mines, Sultana and Mikado Gold Mines, in New Ontario. The instructors will be Dr. W. L. Goodwin, director of the School of Mining, Kingston, and M. B. Weekes, B.A., Sc., fellow of assaying and metallurgy in the School of Practical Science, Toronto.

Tellurides have been discovered in the Norway Mountain, near Rossland.

American capitalists, Col. J. McNaughton, E. Seymour and W. C. Thompson intend erecting a reducing plant at Dartmouth, N.S., for reducing gold concentrates. The plant will have a capacity of 300 tons a month, and if the experiment is a success the works will be enlarged for the treatment of common ores.

An iron claim which is now attracting attention in Canada, lies on Canadian Labrador, off Anticosti, and consist of millions of tons of magnetic iron sand. It has not been used for commercial purposes because of the presence of titanium in it, a substance detrimental to its smelting, but an inventor has recently patented a new process which extracts the titanium and enables the fusible elements to be properly worked.

Peter Dow and party have arrived at Dawson from the Tanana, after two years' travel through that district. They tell of the discovery of a great mountain of prophyric quartz, west of Tulvana River, which could be seen for many miles glistening like snow on the mountain. The quartz was pure white and there were pinnacles standing to a height of 300 feet. Gold was found in all the pieces of quartz tested in a crude manner by the miners.

S. Arden Singlehurst, manager of Howard Gould's mining enterprises in the Omineca country, B.C., brings news that he has struck a rich vein of copper quartz in Mr. Gould's mine, the Ptarmigan. The ore assayed 500 ounces in silver, 4 per cent. in copper, and 2 ounces in gold. He says he has secured for Mr. Gould the richest quartz proposition in British Columbia. A wagon road has been built to salt water, and a large force of men will be put on to work the mine. Omineca is booming owing to this strike.

The Dominion Government in response to the deputation which visited the Premier on April 15, on behalf of the British Columbia mining interests, whose ore the American smelter owners refused to accept for refinement, has granted a bonus of $5 per ton on lead mined and refined in Canada. This will lead to the erection of the much required smelters and refineries and extract the British Columbia miners from the slough in which they had been placed by the action of the American smelter owners

Under the mines act of Ontario of 1900 power is taken to impose a tax of $10 per ton upon ores of nickel, or $60 per ton when such ores are partly treated or reduced, whilst ores of copper and nickel combined are liable to a tax of $7 per ton, or $50 per ton if partly treated or reduced. It was contended by the Dominion Government that these taxes were an export duty, and therefore an interference with the rights of the Federal Parliament, as affecting trade and commerce. Instead of disallowing the act, however, it has been decided to refer the question to the courts, and the decision will be awaited with interest.

A remarkable strike has been made at the Tyee mine on Mount Sicker, British Columbia, where the north vein of the lead was struck in a new cross cut, disclosing an ore body of three feet. The mineral is known as sylvanite, and is said to be similar to that of the Comstock lode in Nevada. Old Comstock miners predict that the assays will range from $100 to $500, and that the Mount Sicker ore is superior to the Comstock. A phenomenal feature of the strike was in the discovery of free gold in the middle of a large sample of ore, which was being made ready for shipment to England. On being broken up, a nugget of wire gold was exposed, measuring 1-16 x1¼x⅝ inches.

The Leyland Line of steamers has been purchased by J. Pierpont Morgan & Co., and it is reported that it will be consolidated with the Atlantic Transport Line. The Leyland Line owns 63 steamships, 12 of them large passenger carriers. It operates lines between New York and Liverpool; Boston and Liverpool; Boston and London; Portland, Me., to Antwerp; Quebec to London; New Orleans to London and Liverpool; Liverpool to Barbadoes, St. Thomas and Trinidad, and Liverpool to Portugal, Egypt and Constantinople. The Atlantic Transport Line owns 17 steamships and is building six or eight more.

Railway Matters.

The double-tracking of the G.T.R. between Hamilton and Niagara Falls, 43.51 miles, has been completed between Hamilton and Jordan, 26.46 miles.

At North Bay on the 28th May, Mackenzie & Mann signed a contract for the clearing and grading of the first section of the Nipissing and James Bay Railway. The work is expected to proceed at once under Henry K. Wicksteed, C.E.

On May 22nd the Northern Pacific railway system in Manitoba, embracing nearly four hundred miles of line, was taken over by the Manitoba Government. It will be operated by the N.P.R. until Mackenzie & Mann unite it with their system.

James Conmee, M.P.P., reports that 250 miles of the Rainy River Railway have been constructed, and about 2,000 men are at work on the intervening gap of about 100 miles, which may be completed with the exception of heavy bridge work by August.

Trains are running over 50 miles of the Algoma Central, including the Michipicoten branch, and 20 miles more will be completed in June. Settlers, Mr. Conmee says, are going into the country north of the "Soo" in large numbers. One hundred houses were recently built in the "Soo" for workmen, while a contract has just been let for another hundred.

The C.P.R. has found the large marine-geared Shay locomotive to have been a profitable investment. This peculiar looking locomotive was built at Lima, Ohio, and was purchased by the company about six months ago. It's speed is much inferior to that of the ordinary locomotive, but its power is greater. Such an engine is admirably adapted for climbing the long, heavy grade between Trail and Robson.

The White Pass & Yukon will run a refrigerator service this year. A number of refrigerator cars are now being built at the company's shops at Skagway; and modern refrigerator plants are being constructed for the steamers "Dawson," "Ogilvie" and "McConnell," which will run between White Horse and Dawson. The schedule will be arranged to have one of these steamers leave White Horse for Dawson every other day.

The New Brunswick Coal and Railway Company have elected the following board of directors: E. Hutchinson, C. A. C. Bruce, R. A. Irving, A. P. Barnhill, F. Stetson, E. B. Winslow and W. Kitchen. The directors chose the following officers: E. Hutchinson, president; F. Stetson, vice-president; Geo. W. Allen, M.P.P., of Fredericton, secretary and solicitor. This company proposes to build a railway from a point in the parish of Chipman, Queen's county, to Gibson, 45 miles, and to develop the coal fields of Sunbury and Queen's.

Premier Bond has announced that the difficulty between R. G. Reid and the Government of Newfoundland will soon be settled. It is said that Mr. Reid has expressed his willingness to turn over the telegraph lines to the Government and to give titles to some residents upon his land grants who have been termed squatters. It shall be optional for the colony to take over the railways at the end of 50 years by paying back $1,000,000 with interest, and paying also for all improvements made. In return for his concessions to the Government Mr. Reid is to receive $300,000 to build stations on the line.

It looks as if Sir William Van Horne, chief of the syndicate that is engaged in planning a network of railroads for Cuba, has outwitted the various promoters, who have been waiting for a change of American law or government. Sir William foresaw that he would have competition if he waited, and set out to purchase rights of way for his company. He bought all existing lines on the island and then purchased thousands of acres of farm lands extending across Cuba from Havana to Santiago and transversely to the north and south. The only favor he has to ask from the government is permission to cross public roads. Secretary Root who was in doubt as to whether he could give this permission under the provisions of the Foraker civil government act, has decided to give the benefit of the doubt to Sir William Van Horne and the railway syndicate controlled by him will proceed with construction work.

The Musquodoboit Railway Co., J. W. Greer, president, and M. H. Fitzpatrick, vice-president, is being formed to connect Musquodoboit, a large agricultural district with the Intercolonial Railway, and it seems likely that operations will be commenced early next year.

Negotiations are reported between the Hull-Aylmer Electric Railway Company and the Montreal capitalists, who control the Pontiac Pacific, Ottawa, Western and Northern Railways, and the Interprovincial Bridge Company. If the deal goes through, it will give access to Ottawa Central station.

Marine News.

The Revelstoke, B.C., Navigation Co., Ltd.; capital, $25,000; has been incorporated.

The Upper Ottawa Navigation Co. have launched a new $3,000 steam tug at Pembroke, Ont.

We learn that there is no truth in the report current last month, that the American Shipbuilding Co. intended to start a shipyard in Canada.

Captain W. H. Smith was found dead in bed at Halifax. He was a former captain of the Allan boats and nautical adviser to the Dominion Government.

J. & J. T. Mathews, Toronto, have recently placed their order with the Smart-Eby Machine Co., to re-build the engines on their steamer "Advance," at Owen Sound.

The Ottawa Electric Railway Co., contemplates placing a steamboat on Lake Deschenes and the upper Ottawa, large enough to accommodate several hundred passengers and similar to the type employed on the Mississippi river.

Hon. J. I. Tarte states that in addition to the employment of grain carriers of the largest size on the upper lakes, a fleet of steel barges, each costing $100,000, will before long be placed on the route between Port Colborne and Montreal.

At a meeting of the Yarmouth, N.S., Steamship Company on May 2nd, a resolution was passed authorizing the sale of the company's stock for $275,000. The motion was strenuously opposed, and the president, Hon. D. McPherson, immediately tendered his resignation.

The steamer "Lake Champlain," equipped with the first Marconi system of wireless telegraphy to be installed in a trans-Atlantic vessel, left Liverpool for Montreal on 22nd May. The big liner communicated with the shore two days after leaving the Mersey, and two days before arriving at Quebec. A communication made while off the Welsh coast, was quite successful.

The government telegraph system was, during the past season, extended along the north shore of the St. Lawrence to the Strait of Belle Isle, and it was intended to connect Belle Isle by a cable, but the loss of the steamer "Newfield" has postponed the work. Lloyd's are considering the feasibility of connecting Belle Isle with the mainland by a system of aerial telegraphy, so that communication would not be interrupted by a break in the cable.

It is announced from Paris that the Franco-Canadian steamship line, subsidized by the Dominion Government to the extent of $100,000, expects the French government also to subsidize it. The line is to run from Havre and Bordeaux to Quebec and Montreal. The present ships will be replaced by four new vessels, two to be built in England and two in France. Efforts will be made to enlarge the scope of the 1893 treaty to include in the minimum tariff as many articles as possible. F. H. Clergue is interested in the line.

The following items for the Welland Canal were voted in the supplementary estimates brought before the Dominion Parliament: Improvements at Port Colborne harbor, $350,000; to deepen portions of summit level, Welland canal, $30,000; to lower mitre sills of entrance lock, Port Colborne, $15,000; to deepen canal from Port Colborne to Humberstone, $85,000; to rebuild Marlatt's bridge, $10,000; to raise walls of old canal locks, $7,000; to rebuild dam and bridge at Dunnville, $43,000; to renew dock below lock 1, $11,800; to establish a new life-saving station at Long Point, $20,000.

The Dominion government has awarded the contract for a new steel twin screw steamer to replace the "Newfield" to Fleming & Ferguson, of Paisley, Scotland. The steamer will be engaged in the lighthouse service in Nova Scotia waters. She will also lay the projected cables between the Maritime provinces and the Magdalen islands. The difference between the lowest British tender and the lowest Canadian tender was $50,000.

The new steel hull for the dredge "Killkenny" was launched from the shipyards of Beatty & Sons, Welland, on the 9th May, in the presence of a large crowd. She is one of the largest and amongst the first steel hulls built in Canada. Her weight is estimated at 200 tons, and is 100 feet long by 36 feet wide by 10 feet deep. Operations were commenced after the new year. A new shop was built and fitted with suitable lifting gear for handling the plates; a large sized combined shear and punch for working the plates and structural material, and in fact, a complete equipment of tools necessary to carry on the work had to be procured. Practically, the whole work had to be done outside, and allowing for the number of lost days, when the weather absolutely shut down on work of any kind, the time occupied was about three months. The launching of a vessel demands skill and experience, but under the direction of A. O. Beatty all the preparations were most successfully carried out. When the trip holding the hull was knocked out, the weight held the structure a few minutes, but a little gentle persuasion started the "Killkenny" down the incline to her future element where she floated magnificently. Very great credit is due Beatty & Sons for their enterprise and management in successfully starting what is practically a new industry in town. A measure of credit is also due to the successful labors of the draughtsman, Robt. L. Hamilton.

Electric Flashes.

A bylaw for extending the present electric light system in Thorold, Ont., has been carried.

"Le Trifluvien" reports that the tramway from Three Rivers to Shawinigan is now under construction, and is being pushed rapidly forward.

At Moncton, N.B., the electors defeated the proposition that the city take over the street railway for $12,000. The railway has since been sold and is being dismantled.

Vancouver, B.C., has granted an 18-year franchise to the Stave Lake Power Company to supply light and power within the city.

The Hamilton street railway is about to extend its line to Bartonville. The company has a free right of way in the township till 1928.

Engineer Hillman has received instructions from the Cataract Power Company to proceed with the survey for the extension of the Hamilton Radial Electric Railway to Oakville.

A proposal is made to transmit electric power from Nottawasaga River to Stayner, Ont., 6 miles distant. The scheme would give enough power to induce manufactories to locate there.

The Lachine Rapids Hydraulic and Land Company contemplate erecting a plant for fuel gas at a cost of $1,000,000 and to sell their product in Montreal for fuel and heating in competition with the Montreal Light, Heat and Power Co.

Owing, apparently to the determination of the Senate to see that the public interests were safeguarded by retaining control of telephone rates the Bell Telephone Co. withdrew its bill asking power to double its capital stock.

Signor Marconi announces that he has successfully installed his system of wireless telegraphy in a steam motor car, and that he is able thereby to communicate with a base while travelling. The War Office officials in London are about to witness a demonstration of the claim.

London and Port Burwell, in Lake Erie, will soon connect by an electric railway, the new company being the London, Aylmer and North Shore Railway. Most of the municipalities concerned have granted the franchise.

A prosperous electric lighting plant is offered for sale in eastern Ontario. Particulars in another column.

The Cataract Power Company, of Hamilton, Ont., has concluded negotiations with the Dundas Electric Light Company, and will take over the business and rights of that company.

A. J. McDonald, who has been in charge of the central division of the Montreal Street railway, has been appointed superintendent of the City of Mexico Electric Railway Company.

The Jones & Moore Electric Co. report the following motor sales among others: Canada Crown Cork Co., W. Northrop & Co., Cohen Bros., Arthur & Co., Mashinter & Co., the R. Simpson Co., Bank of Nova Scotia and Allcock, Laight & Westwood.

A recent amendment of the law relating to the inspection of electric light, which will increase a section of the Inland Revenue Department's work, enables any consumer to have his meter tested by a government inspector. The fee for this inspection is 50c., to be paid by the consumer if the meter proves to be correct, but otherwise by the electric light company. The correction may be carried back three months. This applies also to errors in gas meters.

The International Rapid Transit Ferry Company, incorporated under the laws of Delaware, has taken over the franchises of the International Ferry Company and Fort Erie Ferry Railway Company, and will build electric lines connecting Buffalo and Fort Erie with Crystal Beach, the Fort Erie race track, Niagara Falls and Toronto. T. C. Fenyear, general agent of the Westinghouse Electrical Manufacturing Company, is president of the new company.

A Quebec charter has been granted to the Provincial Light, Heat and Power Co.; capital, $500,000. The incorporators are Allan MacDougall, of Three Rivers; John Hyde, Montreal; Alexander Falconer, Westmount; E. P. Ronayne, Montreal; James Galbraith, Lachine, engineer, and Dr. Henry Joseph Harrison, Montreal. The company is to take up the charter of the Canadian Electric Light Co., and to furnish electric light, power, etc., to the municipalities west of and including the city of Three Rivers.

The English parliament has granted a franchise for the Behr mono-railroad, to be operated by electricity, between Manchester and Liverpool. An attempt to secure a franchise last year failed, owing to the opposition of existing railways connecting the two cities. It is proposed to run cars at a speed of over 100 miles an hour on this line. The rail is in the form of an inverted V and a car is suspended from each edge of the V. Instead of a long train of cars there will be a service at frequent intervals of the cars in single pairs.

The troubles of the Orillia power development scheme are not yet over. The Packet of 23rd May says: The water has fallen 38 inches at the Ragged Rapids, and R. H. Patriarche purposes sending in men to begin work on the 1st of June. It will be several weeks, however, before things can be got back to the point at which they were when the floods came, owing to the washing away of the temporary structures. To complicate matters, Peter Ryan, of Toronto, who has been financing the contract lately, has sued Patriarche for certain stock in another company offered as collateral security; while certain landowners along the Severn River are suing the town of Orillia for damages caused by the overflow from the temporary dam.

An order-in-council passed last month authorizes the Niagara-Welland Power Company to commence work. The company's plan is to tap the Welland River east of the canal and by means of a cut to carry the water of the Niagara and Welland rivers to the high bluff near St. Catharines, where a fall of over 180 feet may be obtained, and thence waste into Lake Ontario. This route also gives three other falls of 33 feet and 56 feet below the bluff, or a total fall of about 300 feet. The capacity of the waterway will be over 100,000-w.h.p., which at the first fall will produce over 75,000-e.h.p. at the wheel, still leaving three falls for later development. There would be a primary installation of 30,000-e.h.p., a large part of which they hope to transmit to Toronto, the balance to be used at St. Catharines.

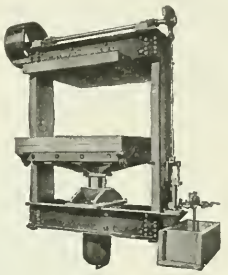
John Fenderson & Co., of Sayabec, Que., have ordered a new electric light dynamo from the Jones & Moore Electric Company.

The News Printing Co., of Toronto, have installed an electric motor to operate their plant. The machine was manufactured by the Jones & Moore Electric Co.

Ulric Rouville, a Parisian capitalist, who owns a large number of lots in the phosphate district at Buckingham, Que., has asked for a subsidy for a proposed line of electric railway from Buckingham, 100 miles up the river du Lievre to Rapide l'Orignal. He proposes to gain power for operations from the numerous falls along the river. The scheme is for the purpose of developing the phosphate and other resources of the district.

HYDRAULIC PRESSES.

While hydraulic presses have been used in the Dominion for a number of years they have in nearly all cases been manufactured out of the country. This line of presses is now manufactured by Wm. R. Perrin & Company, Church street, Toronto, who make a full line of hydraulic, power and filter presses. The rapid growth of the use of hydraulic presses has come from the fact that they are capable of giving so much greater pressure than can be obtained by the other construction of presses, and from their being less liable to getting out of repair than any other press. The tanners have been one of the last to adopt this style of press, but now the hydraulic press is the only press in demand in tanneries. The Harris Abattoir Company and the Wm. Harris Company are putting the large sized 14-inch cylinder presses in at present to press their tankage before drying. It has been fully demonstrated that the tankage will yield a larger per cent of grease after the pressing than by other construction of presses.



HEATING A PUBLIC BUILDING.

A subscriber writes: Our school board have been heating the public school buildings with hot air. We are considering whether it would be advisable to change the system and substitute hot water or steam. As chairman I would like your opinion as to which of the systems you would recommend, and the estimate of the consumption of fuel of each system.

In reply we would say that there are many conditions which should be taken into account before one system can be recommended in preference to another. These conditions would have to be known before a satisfactory answer can be given. In reference to the three systems of heating, namely hot air, hot water or steam, hot air is in a different class altogether to hot water or steam, and is certainly not a good medium to heat a public building with. The ideal system of heating a school building would be the indirect heating system, using steam to supply the heat, that is bringing in a large percentage of fresh air from outside and passing it in over coils of steam pipe. In this way the building is perfectly heated and ventilated with the same system. This, however, is more expensive to operate than direct radiation with either steam or hot water. Hot water is considered a cheaper method of heating a building than steam, and can also be taken care of by a less intelligent man. As to the cost of heating the public school in question it is impossible to estimate this without knowing the conditions. Between steam and water the real cost is in favor of water, but the hot water heating will cost

more to install, due to the fact that it requires larger radiators and larger mains. The proper thing to do is to get a man to look over the buildings and make a recommendation as to the system best adapted to each particular building. In this 20th century the health and comfort of pupils should be the greatest consideration, and for this reason we recommend the indirect heating system.

CHIMNEY VERSUS FAN.

BY A. W. BAYARD, M.E.

The chimney has long been the commonly accepted agent for supplying the fuel of steam boilers with that amount of oxygen which is demanded for combustion. For draft production, however, the chimney is an extremely wasteful contrivance. For years and years it has served its purpose, after a fashion, and even to-day it were folly to say that the huge tube had outlived its usefulness. However, the rapidly altering conditions of modern industry are productive of many radical changes in methods and processes. Rapidity is now the order of things, and economy is a vital consideration. As a result of these economic forces the mechanical draft fan entered the field against the chimney, and by reason of many advantageous features, soon firmly established itself. Before attempting to bring out the many advantages of mechanical draft, it would be well to state the case against the chimney.

The active force causing the flow of air and gases is the difference between the weight of the column of hot gases inside the chimney and the weight of a column of external air of the same dimensions, the height being measured from the level of the grate. Hence, for a given chimney, this force, and consequently the volume discharged, increases with the difference in temperature between the external air and the gases. This force is a comparatively small one. For instance, in a chimney 200 feet high, with a temperature difference of 500 F., the pressure per square inch is less than an ounce, though the theoretical velocity due to this is, of course, quite high, owing to the lightness of air. By reason of the many obstructions to the flow of air, such as the grate, fuel, flues and elbows, as well as the skin or surface friction of the chimney, only a small fraction of the theoretical velocity is attained in practice. It must be remembered, however, that although the draft intensity and the volume of air moved increases with the temperature of the gases, the density decreases at the same time, so that between 600° and 700° F., a temperature is reached at which the weight of air handled is a maximum. Hence it will be seen that a chimney fixes once for all the maximum power of the boiler plant. If the heating surface is such as to allow the gases to pass away at a greater temperature than the critical one for the particular chimney, great unnecessary waste is entailed, whereas, if the products of combustion are cooled to a lower temperature by the heating surfaces, the intensity of draft, the rapidity of combustion, and hence the furnace efficiency, is correspondingly reduced. If considerations of economy demand an economizer of feed water heater, it is found that to obtain the necessary draft a chimney more than 200 feet in height is essential.

Large chimneys require heavy substantial foundations, often with extensive piling. They occupy a ground space in many cases of great value. They are invariably expensive, and the interest on the fixed capital, represented thereby, is considerable. Tall chimneys must be protected from lightning, and are not infrequently wind-wrecked.

In addition to limiting the boiler capacity, a chimney gives a fluctuating draft, due to varying atmospheric conditions. An increasing external temperature not only lowers the draft intensity, but it also increases the volume of air which must be handled, in order that a given weight of oxygen may be supplied to the fuel. Varying barometric and hygrometric conditions likewise have their effect. For instance, the effective heat of the furnace is reduced by an amount necessary to vaporize the moisture entering with the air, which may be considerable.

The chimney is purely and simply a device for moving air, and for such purposes a more wasteful mode could hardly be devised. Since heat is convertible in a definite ratio into mechanical energy, we can easily compare the work accomplished with that which is expended. Assume, for example, an interior temperature of 500° F., and an exterior temperature of 32°. Then a simple calculation will serve to show that the heat in one pound of the gases above 32° F., is equivalent to sufficient mechanical energy to raise its own weight approximately a height of 90,000 feet. If, therefore, the chimney is but 100 feet high, only one nine-hundredth part of the heat is utilized. In other words, the efficiency of the chimney is about one-tenth of 1 per cent., the remaining 99.9 per cent. of the energy overcoming the flue and chimney friction, escaping as radiant heat, or being discharged at the top as sensible heat of the gases. This latter factor is by far the largest, of course. We can see from this also that the efficiency of a chimney increases as its height; a 500-foot chimney would transform into useful effect one-half a per cent. of the energy supplied it. If now we replace the 100-foot chimney by a fan, the efficiency of this arrangement with boiler and engine, may well lie somewhere between 3 and 4 per cent., or from 30 to 40 times as great as the chimney, a figure that will be greatly increased if the fan-engine exhaust is utilized. This brings us to a consideration of draft production by mechanical means.

The steam jet, as a method of draft production, is a device of exceeding wastefulness and will not here be considered. The use of the fan for draft purposes may be classified under the heads of forced and induced draft. The first of these methods consists of forcing air under the grates of the furnace, and may be applied either by the closed ash pit or the closed stoke-hole system, the latter being extensively used in naval practice. Forced draft is usually installed to provide for greater steaming capacity, to help out an overloaded chimney, or to enable low grades of fuel to be successfully employed. The first cut illustrates the application of forced draft to a battery of three boilers. The Buffalo direct connected three-quarter housing steel plate fan, delivers air to a brick duct leading through the bridge walls, where dampers control its admission into the ash pit. Mechanical induced draft consists in the application of an exhaust fan between

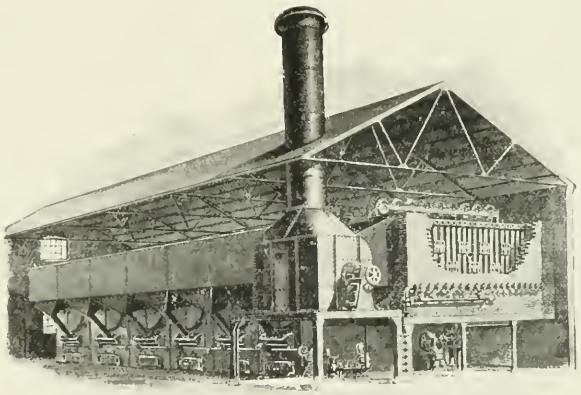
the boiler and the stack, which by withdrawing the gaseous products of combustion reduced the pressure in the smoke connections of the boiler, and hence increases the effective draft pressure. In other words, for the chimney is substituted a mechanical agent, at once vigorous, positive and flexible. With a chimney the gases cannot be cooled below a certain point, which means unavoidable waste of heat. With a fan, however, the minimum temperature has no effect upon the draft and hence a great deal of heat may be utilized by passing the gases through an economizer or other heat-abstracting device. By a proper application of an economizer and induced draft fans to a boiler plant, a saving of from 10 to 15 per cent. may be readily effected.

Turning to the furnace, it is found that the most important losses there are caused either by too little or too much air. Average coal requires for perfect combustion a theoretical air supply of about twelve times its own weight, but in practice it is found that, to provide for oxygen which escapes combustion utilization, a varying percentage of excess must be supplied. If too little oxygen is furnished, the coal burns to carbonic oxide, and in doing so developes less than one-third as much heat as it does if it obtains enough air to burn to carbonic acid. Here there is an important source of loss from insufficient air. On the other hand too much air is productive of loss. In general, the higher the furnace temperature the greater is its efficiency. If now a greater volume of air enters than is necessary to effect complete combustion, the heat developed cannot raise the greater volume to as high a temperature, in addition to which the increased amount of moisture entering with the air acts to decrease the temperature and heat-imparting power. This increased volume must also move at a greater velocity, and consequently give up less heat. Hence too much air means loss all around. Again, during the progress of combustion the gases in the furnace evolve finely divided particles of carbon; if oxygen is supplied to these while they are hot, they are burned, but if they are chilled below their temperature of ignition, they pass off unburned as smoke. The panacea for all these ills is, of course, a proper supply of air in which the excess is just that required for most efficient combustion, and this state of affairs can most readily be brought about by means of a fan. Induced draft, allowing a thicker bed of coal, affords a more intimate commingling of the oxygen with the fuel, and thus decreases the excess of air needed; it also increases the rapidity of combustion. For these reasons the furnace temperature, and hence its efficiency is increased, premising of course, a properly proportioned heating surface.

Another important advantage of induced draft is the ability to make use of low grades of fuel, which could not otherwise be employed. In places where both anthracite and bituminous is available, a mixture of 75 per cent. of the former with 25 per cent. of the latter produces the best and hottest fire, with the practical elimination of the smoke nuisance, a matter of some weight within the limits of certain cities. In addition, induced draft provides for future increase of capacity, for more steam at any time may be had by an extra turn of the fan-engine throttle. In this way also toso lute independence of atmospheric conditions is secured. It desired, the boiler pressure may be maintained constant by an automatic device regulating the fan engine or motor, so that a decreasing boiler pressure, due to increased steam consumption or otherwise, causes the fan to speed up.

As to the comparative expense, the cost of fans, engines, connections and short light stack, represent but a small fraction of the outlay necessary for a chimney. The fans need little or no foundation in fact, they can be placed above the boiler floor level, and ground space thus economized. In addition to low first cost, the maintenance cost is low, and, in fact, if the fan-engine exhaust is utilized for heating or other purposes, as is often the case, this expense becomes of no moment.

The second of the accompanying cuts shows a type of Buffalo duplex induced draft apparatus, with steel-plate fans, housings and connections to the stack. The gases enter the fan wheels in a direction parallel to their axes, from a connection between the fans and are discharged radially from the tips of the wheel blades upward through the connections to the short stack of sheet steel. The last cut shows a slightly different form of apparatus, with Buffalo vertical direct-connected engines, overhung fan wheels and water-cooled bearings. In connection with the six boilers and the induced draft apparatus, is shown an economizer and automatic stokers. With the latter system mechanical draft goes hand in hand. The plant shown here is typical of advanced boiler practice.



In conclusion the writer wishes to make acknowledgment to the Buffalo Forge Company, of Buffalo, N.Y., mechanical draft experts, from whose installations these cuts have been obtained.

EDISON'S NEW STORAGE BATTERY.

Thomas A. Edison has invented a light-weight storage battery which, in the opinion of some electrical experts, will solve the problem of applying electricity profitably to the propelling of vehicles and boats. Mr. Edison set himself the task of finding a cell which should possess the following advantages: 1. Absence of deterioration by work. 2. Large storage capacity per unit of mass. 3. Capability of being rapidly charged and discharged. 4. Capability of withstanding careless treatment. 5. Inexpensiveness. He believes that the new cell may claim these advantages. The negative pole, or positive element, corresponding to the zinc of a primary cell, or the spongy lead of a secondary cell, is iron. The positive pole or negative element, corresponding to the carbon of a primary cell, or lead peroxide of a secondary cell, is a superoxide of nickel believed to have the formula Ni_2O_3. The cell is therefore a nickel-iron cell, a name which suggests the structural material—nickel-steel. The electrolyte is potash: viz., an aqueous solution containing from 10 to 40 per cent. by weight, but preferably 20 per cent. of potassium hydroxide.

the freezing temperature of which is 20 degs. below zero F. or —30 degs. C. Charging and discharging rates are alike. That is to say, the cell may be charged at the normal rate in 3½ hours; or, it may be charged at a relatively high rate in one hour, with no apparent detriment beyond a somewhat lowered electrical charge efficiency. In other words, the cell does not appear to be injured by overcharging or discharging, and only suffers in electrical efficiency under such treatment. The positive and negative plates are mechanically alike, and can scarcely be distinguished by the eye. They differ only in the chemical contents of their pockets. As regards cost, Edison believes that the new cells can be furnished at a price per kilowatt-hour not greater than the prevailing price of lead cells. Lead batteries, however, weigh from 125 to 180 pounds per h.p.-hour, while the weight of the new battery is only 55 pounds and it can be charged in half the time required for the lead battery. This will mean a great reduction in expense, because while the lead batteries will only carry a vehicle about 30 miles, the new one will travel from 75 to 100 miles with one charge. Edison has already started the building of factories at Bloomfield and Silver Lake, N.J., for the manufacture of the new batteries. Succinctly expressed, Edison's invention is the use of iron and nickel-oxide plates in a solution of potash, instead of the old time lead zinc and sulphuric acid process.

THE FUEL AND POWER OF CANADA.

Editor CANADIAN ENGINEER:

Sir.—In your very suggestive remarks on the prospects of Canada and the British Empire in the grand struggle for industrial supremacy in the twentieth century, you do justice to the unrivalled waterpower of British America. And well we may rely on the tremendous reservoir of force furnished alike by our Great Lakes and our wonderful watershed in New Ontario. Rising from the Great Lakes proper, to the north, you ascend a series of terraces with sharply defined escarpments down which fall rivers out of all proportion to their apparent length upon the map. These are not only the outlets of a lake system only now being intelligibly mapped out, and of equally extensive muskegs or bogs, that never allow the summer droughts to deplete them. The plateau occupied by this unique system is about 1,000 feet above the Lake Huron and Lake Superior level, and consequently about 1,600 feet above the ocean. Its foundation is the granite backbone of Canada—running from the Adirondacks in New York to the mouth of the McKenzie. Its width in entering Canada is from above Kingston to Brockville and the Thousand Islands, the submerged area giving passage to the St. Lawrence. In its westward trend, rise nearly all the rivers of Ontario, save the Grand and Thames; and from Perth to Great Bear Lake, the canoe will carry you along without one insuperable portage. Its average width is probably about 80 or 100 miles, half the area of which is water or peat marshes. What the glacial drift has left in these wondrous depressions in Canada's great wall will be a problem for the scientist of the future. Will their bed rock deposit prove the black sands, rich in gold and platinum, whose upper layers have been carried on, even to the northern shores of the Great Lakes? Will the theory that diamonds will yet abound in this region be substantiated? I may mention that thin layers of auriferous sands are frequent between the Spanish and French; that carbonaceous material necessary to generate the diamond during volcanic action really abounds through the Huronian and Laurentian in form of graphite and anthraxolite, and needing only its contact with volcanic centres of action to reproduce the conditions of South Africa. Immediately north of this granite plateau occur sand stones and limestones similar to the coal-bearing areas in British Columbia, and frequent exposures of lignite (brown coal or fossil peat), while true coal of a variety approaching anthracite has also been found. A sample given me by a hunter from a point about 70 miles north of the C P R (as he pointed on the map), was certainly not mined, but the top layer of a float chunk, lying on the surface. If you add to the 1,000 feet of fall, on the southern escarpment, the unestimated wealth of the Huronian areas, we see a heritage such as few nations have developed. When we annex the plateau, with its timber, peat and iron; and join to its northern declivity 1,600 feet of waterfall with limestone, coal, iron and other minerals, what an industrial prospect unfolds to the imagination! A fall of two feet of rain over an area of say 60 miles by 400 = 24,000 square miles, and (allowing half to be re-evaporated) falling an average of 1,000 feet available for power, will give industrial energy for all America for centuries. Were the peat and coal all used in metalurgical operations, and the timber sawn or pulped (as all timber will shortly be), without a heavy drain on the caloric resources, what an export trade would Ontario develop. But leaving out of view its great agricultural resources, fisheries and fur trade, there is one great source of heat and power which has never yet been reckoned upon though possibly the most readily available of them all. I refer to the copse of thick growth of deciduous trees that follows the forest fires, and ultimately, by the natural survival of the fittest, becomes a forest. The increase of woody fibre per acre is probably as great as in a more mature forest; and if pulverized and pressed into bricks would be available for transit fuel. Its power of rapid reproduction is its best feature.

T. FROOD.

CANADIAN ELECTRICAL ASSOCIATION.

The annual convention of the above association will open in the Russell House, Ottawa, on the morning of Wednesday, the 19th inst. Special rates of $2 to $2.50 a day are arranged for members at the Russell, but other hotels at which rates are arranged are: Hotel Cecil, $2 to $4; Grand Union, $2; Windsor, $1.50.

The following are the chief features of the programme so far as arranged at date of writing:

Wednesday, June 19th.—9 a.m.—Meeting of Executive.

10 a.m.—Formal opening and welcome by the Mayor; President's address; reports of the secretary-treasurer, and of committees; appointment of nominating committee; reading and discussion of papers; general business.

2.15 p.m.—General business and reading of papers.

Thursday, 20th, will be devoted to election of standing committees and reading and discussion of papers.

On Friday the election of officers and selection of next place of meeting will take place.

Among the papers are the following: Prof. Owens, Montreal, "Transformation from Constant Potential Alternating to Constant Current Alternating." J. R. Robertson, Montreal, "The Influence of the Load Factor on the Design and Operation of a Lighting and Power System." K. B. Thornton, Montreal, "Notes on Construction and Protection of Aerial Transmission Lines." O. Higman, Ottawa, "Dominion Electrical Standards." H. S. Doherty, New York, 'On Rates for Electric Light." A paper by E. A. Slade, Quebec, and some topical discussions to be decided upon.

Among the social features are: On Wednesday, a carriage drive around the city, tendered by the citizens of Ottawa. Start from Russell House at 4.30. Band concert at Britannia-on-the-Bay by courtesy of the Ottawa Electric Railway Co. Special cars leave Russell House at 8 p.m.

On Thursday, 12.30 p.m.—Official photograph of the members at Parliament Buildings. Exhibition of the Ottawa Fire Department, 5 p.m., to be followed by a trip by special cars to Rockcliffe Park and the Rifle Ranges. Annual Association banquet, Russell House, 9 p.m.

Friday.—Visit to power houses and other points of interest at the Chaudiere, 2 p.m. Trip to Queen's Park, Aylmer, by courtesy of the Hull Electric Co., stopping at Deschenes Rapids power house and the Capital Power Co.'s power houses.

Mr. Higman will have an electric launch at the service of any ladies attending the convention. The Minister of Inland Revenue invites the members to examine the Government electrical standards. Appointments may be made with O. Higman, chief electrician. The boating, canoe and athletic clubs will give the freedom of their premises to members.

Thomas Henry, born at Woodstock, Ont., and a well known electrician, died last month at Denver, Col., aged 50 years. Mr Henry was the inventor of the trolley car, and operated the first trolley car system in Kansas City. He was appointed a consulting engineer for the General Electric Company of the United States, for whom he worked out many improvements in electric cars.

SEWAGE DISPOSAL.

BY R. S. LEA, M.A.E, M. CAN. SOC. C.E.

(Continued from April issue).

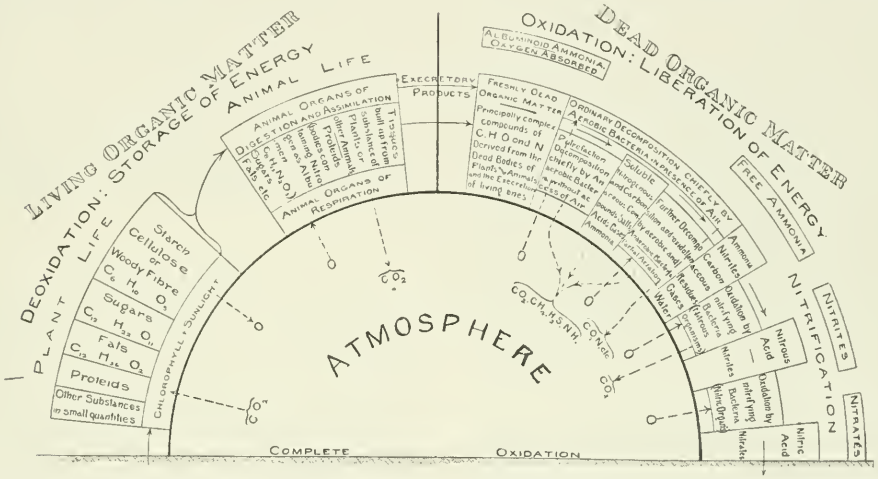
Within the past few years, however, the increase and spread of sanitary knowledge has brought about a change in these ideas, and since 1890, several effective systems of artificial disposal have been built, and are in operation in different parts of the country. Lately, a period of protracted drought has compelled several cities to resort to the use of polluted river water, in order to reinforce their ordinary supplies, and it has become evident that the normal growth will soon compel many of them to turn to the large rivers for their permanent supply. In view of this certain outcome, and of the fact that the rate of river pollution will be much in excess of the growth of population, the wisdom of permitting the continuance of such pollution is at least questionable. In Connecticut and New Jersey legislative action during the last few months has placed the control of the streams in this respect in the hands of bodies appointed for that special purpose.

Evidence of a similar change of public sentiment in other States marks the present time as the beginning of a general movement in this direction. Besides, the experience of the last twenty-five years, in conjunction with the results of numerous observations and experiments, have shown conclusively that many of the systems hitherto proposed are unscientific in principle, as well as incapable of effecting the required degree of purification in an economical manner. So that we have now arrived at a stage where the matter is simplified by the clearing of the field of a number of elaborate contrivances, expensive as well as inefficient.

The evidence all points to the conclusion, that the nearer the process can be kept to that of Nature the more satisfactory will be the results. In fact, in the light of present knowledge, it is probably not too much to say that there is really but one feasible and effective method for the treatment of sewage; or rather that those processes which have been shown to be capable of producing the results required in an economical manner, are based upon the same general principles.

Organic Matter.—Of the different substances composing sewage, only those of organic origin give rise to the necessity for its purification. Hence, by considering the true nature of organic matter, and the changes it undergoes, an idea may be obtained of the operations actually taking place in any of the various purification processes, as well as the essential features of each method, and the conditions necessary for its proper working. With this object in view, the accompanying diagram (A) has been prepared, as a geographical representation of the main facts relating to the origin and constitution of organic matter, and of the subsequent transformations and changes which sooner or later it must pass through.

Organic matter includes all those combinations of the chemical elements whose formation depends upon the processes of life, and which are therefore derived from the substance of either plants or animals. The various forms which it may assume are set out, in the order in which they occur, around the arc of the circle in the diagram—the direction in which the changes proceed being shown by the arrows. The vertical line at the top of the diagram divides these processes into a period of life and growth, and one of death and decay. At the bottom of the diagram, below the line marked "complete oxidation, is represented the inorganic material of the earth's crust, which consists almost entirely of inert mineral substances, whose chemical affinities are completely satisfied, and which are therefore without any kind of available energy. The meaning of this will be evident from the following illustration: When a weight is raised or a spring compressed, an expenditure of energy is necessary, because work must be done—in the one case against the force of gravitation, and in the other against the molecular forces which resist change of shape in elastic bodies. The compressed spring and the lifted weight are now said to possess potential energy, because if the one is allowed to assume its original form, or the other to descend to the



earth, the energy which has been expended upon them will, in some form or other, be set free again. And it must be further observed that there always exists the tendency towards the liberation of energy stored in this way, whenever the opportunity is offered, which renders the arrangement one of instability.

Exactly the same condition of things exists when the chemical affinities (attractive forces), of some of the atoms of a compound for oxygen, say, are unsatisfied. So long as this combination is prevented from taking place, so long may the compound be said to be in a condition of instability, and to possess potential energy, which will become available whenever the oxidation is allowed to take place. This energy is of the same nature and is measured by the same units as that given out by the descending weight or the expanding spring.

Now, the maintenance of life and growth, the power of motion and capacity for doing work, possessed by animals, requires the supply of a corresponding quantity of energy. This we know they obtain from their food, which is ultimately derived from the substance of plants. Plants draw the nourishment necessary for their life and growth from the earth and air, in the shape of materials capable of no further oxidation, and hence entirely devoid of energy. Nevertheless, paradoxical as it may appear, out of such simple, inert materials, the green plants can build up substances, complex in structure, and possessing the rich store of potential energy which fits them for animal food. They are enabled to do this by virtue of a mysterious substance called chlorophyll, which gives them their green color, and which has the wonderful power of absorbing from sunlight the energy necessary for the purpose.

On the left of the diagram, just above the line of "complete oxidation," is a representation of plant life. The space enclosing the words "chlorophyll – sunlight," corresponds to the leaves and other parts of the plant, where this process of food

manufacture is carried on. From the earth by way of the roots comes water (H_2O) nitrates ($K N O_3$, etc.), and other salts in solution from the air, by absorption through leaves, carbonic acid gas or carbon dioxide ($C O_2$), and in the case of some plants pure nitrogen. These stable but inert compounds are here broken apart, a portion of the oxygen removed and returned to the air, and the remaining elements built up into less stable but more complex substances, such as starch, cellulose, sugars, fats, etc. Thus the energy abstracted from the light waves which is expanded in this process of deoxidation, is stored up in these substances, which thereby become capable of furnishing food for animals. Animals, by means of their organs of digestion and assimilation, construct from these materials and incorporate in their tissues, compounds still more complex, but of greater instability. By oxidation in the lungs or other breathing apparatus, they obtain from them the amount of energy necessary to maintain bodily heat and motion, in just the same way as energy is supplied to a heat engine by the combustion of fuel. The animal body not being a perfect machine, does not utilize all the energy in its food, but rejects a large proportion of it in the form of excretions, which share the general fate of all dead organic matter represented on the right side of the diagram.

In the manner outlined above, and in a fashion more or less direct is continually being produced "Living Organic Matter," represented on the diagram to the left of the vertical line. And in due course it will join the "Dead Organic Matter" (shown on the other side of the line), either in the form of excretions of living plants and animals, or their bodies after death; and were it not for the processes of disintegration and decay, which are everywhere in operation, these constant additions would soon accumulate to such an extent as to check and ultimately stop all life by overwhelming it with its own waste, and by exhausting the materials necessary for its existence. It is this second or destructive phase, shown on the right half of the diagram, which is of most interest in this connection, because as we shall see, it represents the changes which take place in the process of purifying sewage.

Sewage.—We are now in a position to return to the consideration of what sewage actually is.

As it flows in the mains of a modern drainage system it is composed of the discharges from water closets, the liquid waste of kitchens and laundries, the drainings of butcher shops, slaughter houses, markets, stables and manufactories; and, where surface water is admitted, the refuse from streets, backyards, etc. These substances are mixed with a varying quantity of water, which is usually at least as great as the ordinary water supply; so that in spite of the great variety of waste materials which it contains, it is, when fresh, a comparatively innocent-looking liquid, cloudy or milky in appearance, but without any particularly disagreeable odor. It is, in fact, dirty water, which contains, partly in solution, and partly in suspension, a certain quantity of organic matter derived immediately from many different sources, but ultimately formed in the manner already described.

The problem of sewage disposal is then the problem of so treating this organic matter, as to destroy it, or render it incapable of offence.

(To be continued)

"COPPER ALLOY" DISC VALVES.

In this time of carrying high steam pressure, there is probably nothing used in the transmission of steam which is giving the team user and the steamfitter as much serious concern as what kind of valve to use. The annoyance and expense experienced by reason of the leaking and giving out of valves, by those who have to foot the bill occasioned by delays through prolonged repairs, the tearing down of pipes in order to get at the fittings causing the trouble, and the expense of replacing the defective member, in many cases, is gradually convincing them that the best valve and the easiest one repaired is the one to buy, even though the first cost be greater than when fitting out with cheaper grades of valves, and taking a chance.

The valve manufacturers at home and abroad have been placing on the market valves, which to all appearances were first-class articles, the material, weight and general outward appearances being all that was desired, but they have neglected the most vital point, i.e., the composition discs and renewable discs and seats which have been widely advertised and recommended, whereby at small expense the discs could be replaced with new ones, and while these renewable discs and seats have proven a vast improvement over the old style stationary ones, they have been made of such material, as to necessitate the renewing of the parts at every short interval, causing expense and annoyance. The question then arises: What is the best metal to use in a disc? This question has presented itself to one of our advertisers, the Kerr Engine Company, Ltd., of Walkerville, Ont., an old established concern, engaged in the manufacture of Straightway, Standard Globe and Composition Disc valves, and they inform us that they have made experiments, and are now making what they term a "Copper-Alloy" Disc valve, which has proven itself equal to the emergency herein related. These discs we understand, are made to fit any Jenkin disc shell, being the same in size. Robert Kerr, managing director of this company, states that his firm will be pleased to discuss the merits of this valve with all users of high steam who are interested.

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

The yearly meeting of the Ontario Association of Stationary Engineers was held in Berlin on May 27th. The meeting opened at 11.30 a.m. A letter of regret was read from the president, who was unavoidably absent. The reading of the minutes, reports of officers, reports of committees, and the appointment of new committees was all accomplished before lunch.

The Registrars report showed over 1,000 names on the books.

The report of the Committee on the Good of the Order was received and fully discussed, and finally passed. Their recommendations were principally along the line of strengthening the means to secure prompt renewals of certificates each year.

The Legislation Committee reported in full the work done for the license law during the last session of the Ontario Legislature. From this it appeared that an amendment to the Factories Act had been passed, making it compulsory that all boilers coming under the act be inspected at least once a year. The committee recommended the appointment of a special committee for the purpose of waiting upon the government concerning the kind of inspection to be made, and to assist in any legitimate way in carrying out the law.

The election of the four members on the board resulted in the re-election of Thos. Elliott, of Hamilton, and A. Ames, of Brantford. The new members were Chas. Moseley, of Toronto, and Geo. Fowler, of Toronto.

The election of officers resulted as follows:

President—Thos. Elliott, Hamilton.

Vice-President—F. W. Donaldson, Toronto.

Registrar—J. G. Bain, Toronto, 113 Yorkville avenue.

Treasurer—A. M. Wickens, Toronto.

The board now consists of the above members and A. Ames, Brantford; Alex. Findlay and F. G. Mitchell, London; A. F. Edkins, Geo. Fowler, O. P. St. John and Chas. Moseley, Toronto; W. F. Chapman, Brockville.

It was decided to resume the work of issuing educational papers, and a committee was appointed to carry out the same. The next yearly meeting will be held in Toronto, on Monday, May 26th, 1902.

IMPROVED GAS ENGINE LUBRICATOR.

The Lunkenheimer Company of Cincinnati, Ohio, have placed on the market an improved form of lubricator for gas, gasoline or oil engines. It is designated by the trade name "Paragon," and the makers are assured that it will adequately fulfill the requirements of the service for which it has been designed. Its construction has been improved over the other forms heretofore on the market and all objectionable features have been eliminated. The construction is very compact, and the general design will appeal to users of this class of goods. It is described as follows:

The filling arrangement consists of a screw-down slide filler. Referring to the sectional illustration it will be seen that the slide (A) screws down on and around the lid of cup and has a loose plug which covers the filling hole when slide is swung over to a closed position. This loose plug is so arranged that the wear on same can be adjusted by turning down screw (B). The whole construction is very heavy, and the slide can be depended upon to seat perfectly and remain tight for an almost indefinite period. On account of this construction it is possible to secure a large filling hole, which, as users know, is a desirable feature. The feed regulating mechanism is the same as their "Sentinel" pattern oil cup, and the feed can be put on or off by raising or lowering the cam lever (C). The rate of feed can be adjusted by turning nut (D), which is prevented from loosening by spring (E). By this arrangement the feed can be set and turned on or off without disturbing the rate of flow. The cup is thoroughly packed both around the stem and at the top and bottom of body and sight-feed glasses and cannot become leaky. The whole cup is secured together by their patented lock-nut construction (not found in other kinds), which makes it impossible for the cup to jar apart, due to the shaking of the engine, and also dispenses with the annoyance of oil leaks. The sight-feed glass (R) is quite large and can be readily cleaned by unscrewing the upper part of the cup from the base piece. These cups are constructed of the best material throughout, and they guarantee it to be the best gas engine lubricator of its class on the market. Where a heavier and more substantial cup is required the manufacturers recommend the use of their "Mars" pattern, which, although not any more efficient, is somewhat heavier in construction. Information as to prices, etc., can be obtained from the makers.

THE METRIC SYSTEM.

There has been an encouraging interest in the chart of the metric system of weight and measures, published by the proprietors of The Canadian Engineer, and already three of the Provincial Governments have reported their intention to introduce it into the schools, while other Provinces are considering the same matter. Two of the leading commercial colleges of Toronto have also acted on the friendly suggestion of the Monetary Times, and ordered the charts for teaching the system.

The Monetary Times, which is without question the ablest financial and mercantile journal in Canada, makes these timely remarks on the chart:

"One of the best aids to a knowledge of the metric system is a chart published by The Canadian Engineer. This gives illustrations, actual size, of the meter (39.37 inches), the kilo (2 1-5 pounds), the liter (1.76 English pints), and the cubic decimeter, which has the same cubic contents as the liter has liquid. The important feature of this system is the ingenious inter-relation of these various measures. This can be better illustrated by diagrams than stated here; and we are of the opinion that the 'Engineer' chart, we now describe, published at Montreal and Toronto by Biggar, Samuel & Co., at ten cents per copy, ought to be secured for our Public Schools. The reason is plain. Canadians will have to adopt this system if they expect to do a successful foreign trade in the future. Fifteen European countries have adopted it. Mexico and the Latin republics of South and Central America are constantly using it. So also with Japan, while the United States will soon make the system compulsory, since they have adopted it for their dependencies of Cuba, Porto Rico, and the Philippines. And much of the success which Germany, Belgium and France have found in foreign trade, much more, indeed, than the British seem to perceive, has arisen from their use of this convenient system.

"The Canadian Engineer has done a real service in taking the trouble to arrange this object-lesson on the metric system, and we trust the chart may, by the action of the Government or otherwise, be made widely known in Canada. The commercial colleges of Canada, if they are alive to their proper educational interests, will give instant attention to the metric system."

NATIONAL ELECTRIC LIGHT ASSOCIATION.

The National Electric Light Association of the United States held its 24th convention at Niagara Falls, May 21st to 23rd. Regarded as a business convention it was not equal to many former gatherings, a circumstance due to the powerful attraction of the Pan-American Exhibition so close at hand. Among the Canadians present, were Frederic Nicholls, H. G. Nicholls and E. D. McCormack, all of the Canadian General Electric Co.; Chas. B. Hunt, London Electric Co.; R. B. Hamilton and G. A. Powell, Packard Electric Co., St. Catharines; Edw. Slade, Jacques Cartier Water Power Co., Quebec; John Murphy, Ottawa Electric Co.; Geo. H. Olney, Eugene Phillips Electric Co., Montreal; R. S. Kelsch, Lachine Rapids Hydraulic & Land Co., and E. F. Seixas, Niagara, St. Catharines and Toronto Ry. Co.

The committee on the standardization of incandescent lamps reported, that owing to recent changes in the shape of filaments it was not advisable to attempt the making of standards this year. The committee for investigating the photometric values of arc lamps, in its report described the novel apparatus in use and results obtained during a year's work in testing the relative values of carbons for enclosed arc lamps. The carbons tested were of both foreign and American make, and the differences between these were shown to be exceedingly small.

Two events of interest to Canadians were the election of Chas. B. Hunt, of the London, Ont., Electric Co., as second vice-president, and the conferring of an honorary membership upon Frederic Nicholls, vice-president and managing-director of the Canadian General Electric Co. There is only one previous instance of this association conferring an honorary membership, and those most interested in the work of the association were unanimous in declaring that the honor had been well earned. Mr. Nicholls worked his way from ordinary membership, step by step, till he was elected president, and during his presidency it was noticed that the business of the association was never better attended to. In that year, Mr. Nicholls made eleven trips from Toronto to New York on association business, showing in this and other ways an amount of personal attention that was quite novel in the history of the presidency. Since then he has shown as much interest in the organization as if he still held a high office; and it may be mentioned that he has not missed a single convention since he joined the association. It will be a satisfaction to Canadians, therefore, to know that the distinction given to Mr. Nicholls is not only well earned but well approved.

The newly elected president is Henry L. Doherty, of Denver, Col., who was recently president of the N. W. Electrical Association, and who is not unknown in Canada, having been connected with the Jacques Cartier Electric & Power Co., of Quebec.

CATALOGUES RECEIVED.

Canadian Composing Co., Montreal, catalogue of Monoline type-setting machines.

Brown & Sharpe Mnfg. Co., Providence, R.I., a booklet descriptive of the exhibits of this well-known firm at the Pan-American.

Jeanesville Iron Works Co., Denver, Col., send an advance sheet, No. 11, describing a compound condensing duplex mine pump, made by the firm.

The Goheen Mnfg. Co., Canton, Ohio, catalogue of testimonials to "carbonizing coating;" a protective paint for iron and steel, made by the company.

Eastern Machinery Co., New Haven, Conn., catalogue of patent friction clutch pulleys, and couplings, friction winding drums, and winding machines for brass mills and other work; friction hoisting gear counter-shafts, etc., with tables and directions.

The B. F. Sturtevant Co., Jamaica Plain Station, Boston, an artistically gotten up catalogue containing lists of various companies and firms using Sturtevant fans and blowers. From the same company a desk catalogue of engines, motors, generators, forges, steam heating apparatus and other products of this well known company.

Marine Iron Works, incorporated, Clybourn avenue, Chicago, illustrated catalogue of marine engines, including stern paddle wheel engines, also marine boilers, propellers, etc.

Robert Bell, Seaforth, Ont., a well gotten up catalogue of traction engines, straw burning engines and portable agricultural engines, also saw mill carriages, sand-brick machines, flax mill machinery and mill supplies.

The Jeffrey Mnfg. Co., of Columbus, O., have issued their circular, No. 61, illustrating coal and ore handling machinery, screens for cement, sand, etc., conveyors for handling pulpwood, refuse, chemicals, stone, fish, etc., cannery and box conveyors, pan, bottle and barrel conveyors and elevators, cable conveyors, endless aprons and tables, basket and package conveyors, chain and bucket conveyors and, in short, appliances for moving and lifting anything.

The Wellman-Seaver Engineering Co., New England Bldg., Cleveland, Ohio, send a fine specimen of catalogue work, illustrated with plans and half-tone engravings of some of the varied engineering work carried out by the company, such as steel works, open hearth furnaces, patent charging systems for steel works, gas producers, reversing valves, cranes, hoisting and conveying apparatus, coal handling machinery, cement works machinery, coke oven machinery, electric ingot strippers, blast furnace engineering, structural work and general engineering.

ENGINEERS AND SURVEYORS.

Among the interesting papers read at the recent meeting of the Ontario Association of Land Surveyors, was one by A. R. Davis, of Napanee, advocating a union of civil engineers and land surveyors under a common corporation. The similarity of their work and the immense field to be opened out in the near future when the more northerly and less known parts of our country begin to be developed call for a more real union of aims and forces. There will be need before long of a thorough geodetic survey to be undertaken by the government if the country is to develop its immense resources. This work would call for the services of an army of men with a wide area of practical knowledge hence the advantage of the amalgamation suggested. At present too much of such work is performed by foreigners to the exclusion of our Canadian engineers and surveyors, and Mr. Davis points out that one effect of such combination as he proposes, would be an increased influence and strength which the members of the combined professions would exert.

LITERARY NOTES.

William R. Perrin & Co., Church street, Toronto, have sent us a very exhaustive treatise on beet sugar machinery, some classes of which are made by this enterprising firm. The treatise is prepared by C. W. Hamburger, who is an enthusiast in the beet root sugar industry, and who gives exhaustive information on every stage of the process from beet root culture to the last step in manufacturing.

"Central Station Experiences" is the title of a 100 page book published by the Power Publishing Co., World Building, New York. The design of the book is to help by familiar talks the central station operator in getting over many of the every day difficulties he has to encounter. It is both readable and instructive. Price in stiff board binding, 75c.; cloth binding, $1.

Macmillan & Co., London and New York, have published "A School Chemistry" for use in high schools and colleges, by John Waddell, B.Sc. (London), Ph.D. (Heidelberg), D.Sc. (Edinburgh). The author has arranged his work in the most simple manner possible, starting with water as one of the most common substances, and carrying the pupil from step to step without burdening his mind with definitions until they are needed, and as they arise from the consideration of the facts investigated. No mention is made of the atomic theory until the pupil has mastered the facts on which it is based. The student is thus able to grasp the real meaning of formulæ when he come to need them. Some of the best educationists in this country and the United States and Great Britain have acknowledged the merits of this text book, and it is a satisfaction to know that so able a treatise is the work of a Canadian, Dr. Waddell, as most of our readers are aware, is now lecturer in Chemistry at the Kingston School of Mining.

Spon & Chamberlain, publishers of technical literature, Cortlandt street, New York, have issued a new hand-book on "Induction Coils," showing how to make, use and repair them. This is the second edition of this useful work, edited by H. S. Norrie (Norman H. Schneider), and has been thoroughly revised and partly rewritten. Among the new matters treated of in this edition may be mentioned, coils for gas and automobile engines, medical coils, new forms of contact breakers, gas lighting apparatus, primary and secondary batteries, X-ray apparatus and wireless telegraphy. There are also a number of new diagrams, making in all 79 illustrations. Price in cloth binding, $1.

The Engineering Times, of London, England, is out with another instructive special number, dealing with railways and tramways. It contains 448 pages in magazine form; price, 2s. 6d. The publishers also announce a special number recording the engineering features of the Glasgow Exhibition.

Insurance Engineering is a new monthly, published in magazine form and devoted "to the science of diminishing hazards to property and life." Its specialty is, of course, engineering as connected with building, and fire prevention is largely a feature of the interesting number before us. The subscription is $3 a year, and it is published by the Insurance Press, 120 Liberty street, New York.

Other publications received are:

The Human Mechanism, by Charles Baillairge, C.E., Quebec, being a reprint of a paper read before the Royal Society of Canada last month on the wonders of the human body.

"Our Wedge," published now and then by Geo. Batten & Co., advertising agents, Park Row, New York: a booklet on advertising.

"The Auriferous Quartz Deposits of Southern British Columbia," by J. D. Kendal, reprinted from the British Columbia Review.

Transactions of Association of Civil Engineers, Cornell University, Ithaca, N.Y.

Fifth Annual Report of Commissioner of Highways, published by the Ontario Department of Public Works, Toronto.

"Memorandum on the Growth of the Traffic on the Great Lakes and the proposed Ottawa Ship Navigation," by the Montreal, Ottawa and Georgian Bay Canal Co., Ottawa. An illustrated pamphlet of 35 large pages with two maps.

Calendar for 1901-2 of the Ontario School of Practical Science, Toronto.

Report of Mineral Statistics and Mines Section of Geological Survey, Ottawa.

Report of Department of Mines of Nova Scotia for 1900, Commissioner of Public Works, Halifax.

Mining Operations, Province of Quebec, 1900; by J. Obalski, Inspector of Mines, Quebec, Que.

Personal.

J. W. Fitzgerald, the well-known surveyor of Peterboro, Ont., is dead.

G. U. G. Holman, for some time connected with the switch board engineering department of the General Electric Company at Schenectady, is the new manager of the Canadian Electric Light Company, of Quebec and Levis, making Quebec his headquarters.

The Commercial Advertiser reports the salary attached to S. R. Callaway's new position as president of the American Locomotive Company is $100,000 a year. He also receives $500,000 of the capital stock as bonus. Mr. Callaway spent his boyhood in Montreal.

W. H. Law, who recently resigned the chief engineership of the Hamilton Bridge Works Co., has been appointed engineer for the Canada Foundry Co., of Toronto, whose large new foundry and machine shops are now in course of construction.

J. D. McNabb, of Lucknow, has been appointed city engineer of Chatham, Ont.

W. R. Russell, of Pembroke, is chief of the surveying staff now engaged on the projected Ontario government railway to Lake Temiscamingue.

L. G. Russell, manager of the Intercolonial Railway, has appointed as his assistant, E. T. Howe, a man of much experience on United States railways.

B. A. C. Craig is now general manager of the Canadian Corundum Co., which controls large corundum deposits in the neighborhood of Combermere, Ont.

Louis Coste, for some years chief engineer in the Public Works Department, Ottawa, has been appointed superintending engineer of the harbor improvement works at Port Colborne.

Thomas Roberts, of Adelaide, South Australia, an engineer representing the state railways of that colony, is now in Canada studying the operation and management of electric railways.

J. G. Bain, of the Atlantic Refining Co., Toronto, and registrar of the Ontario Association of Stationary Engineers, leaves with his wife on the 21st inst. for a two months' trip to the old country, taking in the Glasgow Exhibition.

Thos. C. Moxham., eldest son of H. J. Moxham, general manager of the Dominion Iron and Steel Co., while boarding a car at Sydney on the 5th inst., missed his footing, and was run over and killed. He was only 25 years old, and was a general favorite.

In the Toronto Technical School the new head of the Department of Drafting and Industrial Design is A. F. Macallum; Department of Mechanics and Physics, John McGowan; Department of Chemistry, W. D. Young, and of the Department of Mathematics, Dr. William O'Connor.

Vincent McFadden for years past engineer for the Sydney Electric Light Co. is now superintendent of all the Dominion Coal Co.'s electric light plants. His successor with the light company is W. White, for the past four years manager of the Chatham, N.B., Electric Light Co. Mr. White was formerly a machinist in the shops of McDonald & Co., Halifax.

J. R. Roy, C.E., has been appointed superintendent of Public Works, Ottawa. He is accompanying the Montreal Harbor Commissioners on their tour over the lake ports, studying modern grain elevators. Mr. Roy was for three years chief engineer of the Montreal & Ottawa Railway, and for a like term, engineer and superintendent of the Montreal Park & Island Railway.

C. W. Dill, who succeeds Cecil B. Smith as engineer of the roadway department of Toronto, was born at Bracebridge, Ont., and graduated from the School of Practical Science, Toronto, in 1891. After three years in the office of Willis Chipman, Toronto, he went to New York state, and engaged in municipal and other work. He was superintendent of construction of the steel arch bridge, Niagara Falls, and after this was finished went to British Columbia, whence after a time at Nelson and Rossland he returned to Ontario.

Cecil B. Smith, C.E., has resigned his position as engineer in charge of roadways of the city of Toronto, and has gone into private practice as consulting engineer. He had only a short time before been promoted from the sewers to the roadway department, and his resignation was learned of with regret by both the engineering staff and the board of aldermen. Mr. Smith is the author of a treatise on "Railway Engineering, which has been adopted as a text book by four universities in Canada and the United States. His experience as assistant professor in McGill University, in charge of the cement testing laboratory, and the variety of municipal, railway and other work he has performed with such marked success, gives him an unusually sound equipment for the career he has now entered upon. The frequency with which his advice has been sought in the positions he has heretofore filled is a sure warrant of success in his private practice. Mr. Smith's temporary office is in Parkdale, Toronto.

The Lachine Rapids Hydraulic and Land Co. will on the 15th inst. open the tenders for the new 2,500-h.p. steam plant which it proposes to build as a reserve.

Miscellaneous Notes.

John Inglis & Sons, manufacturers of engines and boilers, are building an extension to their foundry in Toronto.

An English firm has made a proposition to the Canadian Militia Department to establish a rifle factory in Canada.

W. F. Tye, chief constructing engineer of the C.P.R., has moved his headquarters from Winnipeg to the Windsor Station, Montreal.

The W. S. Loggie Co., of Chatham, N.B., are buying a 40-h.p. boiler and engine for their brickyard, from the Robb Engineering Co.

Thoms & Keyworth, of Carleton Place, are building a new boat to be put on the Canadian Mississippi river. She will carry 50 passengers.

E. J. Philip, 48 Front street, east, Toronto, is installing a special ventilating system at the Imperial Varnish Company's works, Toronto.

McOuat & McRae, engineers and founders, Lachute, are building a number of special machines for the Lachute Shuttle Company.

M. Beatty & Sons, Welland, Ont., shipped in one week last month, four hoisting engines, to points as widely separated as Winnipeg, Man., and Truro, N.S.

The bolt and nut department of the Swansea Forging Co. has this month been removed from the company's factory at Gananoque to the head works at Swansea, Ont.

The newly formed Lake Huron and Manitoba Milling Co. will erect at Goderich a mill with a capacity of 1,200 barrels of flour per day.

The Richardson Gold Mining Company have purchased a 100-h.p. Mumford standard boiler for their mine at Isaac's Harbor, N.S., from the Robb Engineering Company.

The Metallic Roofing Co., of Toronto, have at the Glasgow exhibition a striking exhibit in the form of a chapel made of their embossed steel and roofed with their metallic roofing.

The General Engineering Company, Toronto, lately purchased a number of Foster fan engine regulators to be used with their Jones' underfeed stoker system from E. J. Philip, 48 Front street, east, Toronto.

The Crow's Nest Pass Coal Company have ordered from the Robb Engineering Company a 250-h.p. engine for their mine at Fernie, B.C. This is the second engine of this size supplied them within a few months.

At the recent auction sale of the plant and estate of the Abbott-Mitchell Iron Works, Belleville, no bids were made which the creditors would consider, and it is not certain what step will be taken next. Meanwhile the works are closed.

The Beardmore Belting Co., Ltd., Toronto, have just issued a very convenient special telegraph code, which will greatly help their customers and prospective buyers in ordering goods. Users of belting will find this a very handy memorandum book.

The A. A. Griffings Iron Company, through their Canadian representative, E. J. Philip, have sold the following concerns Bundy traps: Brantford Starch Co. and Slingsby Mnfg Co., Brantford; R. Watson Co., Toronto; McLaughlin Carriage Works, Oshawa; St. Vincent de Paul Penitentiary; Dominion Oilcloth Co., Montreal, and Dominion Bridge Co., Lachine Locks.

Reports from the Glasgow Exhibition are to the effect that the show is a very fine one and that Canada is well represented. In addition to 50 athletic contests already arranged for, a number of learned societies will meet at Glasgow during the exhibition. Among these are the British Association, the Institute of Mechanical Engineers, the Society of Engineers and Shipbuilders, the Institute of Chemical Industries, the International Engineering Congress, the International Association for the Advancement of Science, Arts and Education, the Institute of Naval Architects, and other societies.

Harriston has passed a bylaw to lend $10,000 to a company proposing to start a shoe factory there.

Bond & Smith, architects, Toronto, have moved their offices from the Temple Building to 160 Bay street.

The National Iron Works Co. have their new buildings at Wingham about completed, and are now installing machinery

J. S. Anderson, president of the match factory at Walkerville, Ont., burnt last month, has visited Ottawa with a view to locating the new factory there.

The Consolidated Pulp and Paper Co. is to be wound up. The liabilities are $168,642, and the nominal assets, $147,054. Some of the items of assets are much overvalued

It is reported from Quebec that the line from Roberval to James Bay, for a portion of which a subsidy was voted by the Dominion Parliament, will soon be commenced on the first ten mile section.

Charles Potter, optician, has moved from King street east to larger and more prominent premises at 85 Yonge street, Toronto. In addition to scientific instruments and optical goods the firm will keep a stock of cameras.

The bylaw to spend $273,245 on improvements to the Toronto waterworks, and another to lay out $133,000 for new buildings for the Industrial Exhibition, were both defeated on the 31st May by over 2 to 1.

On condition that the Blanche River Pulp and Paper Co. get from the Ontario Government an extension of time to October, 1905,, instead of April, 1904, they will spend $750,000 instead of $200,000 on their pulp works at Mattawa. The extension has been granted.

D. Vanaken, of the Manhattan Contracting Co., of New York, has gone to start work on the Cape Breton extension line, to run from Point Tupper on the I. C. R. to Louisburg, a distance of 100 miles. The company's headquarters will be at St. Peters, and they hope to have the line completed to that point from Pt. Tupper by January next. The road is to be operated in connection with a projected fast Atlantic steamship line.

The Beardmore Belting Co., Ltd., Toronto and Montreal, have secured the contract for all the leather belting for the Grey and Bruce Portland Cement Co., Owen Sound. This order comprises all sizes of belts, ranging from belts 2 inches wide, single, to 40 inches wide, three-ply. The Montreal Cotton Co. have also placed an order with the firm for the belting for their new cotton mill at Valleyfield.

On the 31st May the cable cars of Broadway, New York, were changed to the underground trolley system. The new equipment, the feature of which is a rail beneath the surface, communicating the electric current to a shoe attached to the car, cost over $6,000,000, but the change was made in a single day, and appears satisfactory. All the other surface car systems on Manhattan are to adopt the system, when it is tested, thus doing away with the trolley poles and overhead wires.

The New Process Raw Hide Co., Syracuse, N.Y., has recently added considerably to its equipment by the purchase of new machinery, including three Gleason bevel gear planers, which plane the teeth accurately to cone lines, and an additional automatic spur gear cutter, and is now in the market to make metal gears to order in addition to its well known new process noiseless pinions.

The Cyclone Grate Bar Company, Toronto, are having a good demand for their grate bars. Several of the concerns mentioned have placed repeat orders. The company report the following sales: Two sets each to the following: St. Vincent de Paul Penitentiary, Toronto Paper Co., Cornwall, Ont.; Brockville Asylum for the Insane; Canada Woolen Mills Co; and one set to the following: Brantford Electric and Operating Co., Clare Bros., Preston, Ont; Eagle Foundry Co., Montreal; Waterloo, Ont., Mnfg. Co.; Kinleith Paper Co., and Welland Vale Mnfg. Co., St. Catharines

W. H. Law C.E., of Toronto, formerly of Peterboro', has appointed the London Machine Tool Co., sole agents for the manufacture and sale in Canada of the "Optimates" power hammer recently invented by him. Mr. Law warns users of power hammers from purchasing this hammer from any unlicensed parties. It appears that such a warning is needed, as it has transpired that a certain person having got hold of the patterns of the original machine has been attempting to build and sell it. A description of the improved hammer will appear in an early issue of The Canadian Engineer, and meantime users of power hammers are cautioned to have no dealings with unauthorized persons.

Under the care of Mr. Marquis the Brown & Sharpe Mnfg. Co., of Providence, R.I., has an exhibit at the Pan-American, which every mechanical visitor from Canada should see, and the company extend a cordial invitation to every caller from the Dominion. Among the machines belted and ready to run in the machinery building are a plain grinding machine, a surface grinder, a universal cutter and reamer grinder, two automatic gear cutting machines, two automatic screw machines, besides several milling machines and universal grinding machines, also a measuring machine. In addition to these they have a line of scales, rules, cutters, micrometer calipers, standard gauges and fine measuring tools, the whole being taken from their ordinary stock.

A. C. Douglass, to whom was awarded the contract for the tunnel work of the Canadian Niagara Power Co., at Niagara Falls, started to work about the 20th ult., preparing to sink a shaft, about 200 yards above the falls, at the foot of Cedar Island. Work on this shaft is now proceeding, and when it is sunk to the proposed tunnel level, about 500 men will be put on to excavate the tunnel from both directions—to the wheel pit and the portal at the Horse Shoe falls. The shaft will be completed in about seven months, and the tunnel, which will be 2,200 ft. long, in eight more months.

—The town council of Oshawa has concluded an agreement with the Detroit Wire Fence Company for the removal of their entire plant to that town. The Luke factory, situated on the line of the Oshawa railway, has been bought by the firm for their business, and operations will be begun at once. The company expects to use 4,000 tons of raw material the first year, and will employ about twenty-five hands at the start. There is not now a vacant factory or house in Oshawa.

It is reported that a large pulp company is negotiating for the purchase of the lumber lands owned by the Chappell Lumber Co., in Hants county near Windsor, N.S. R. R. Chappell, manager of the firm of Chappell Bros. & Co., Ltd., of that town, is heavily interested and if the deal goes through the capital of the last mentioned company will be increased to at least $50,000 and Wm. Chappell, of Windsor, will take charge of the manufacturing part of the company's business

---

WANTED—By the Stratford Gas and Electric Light Company, Stratford Ont., a manager. Apply to the president on or before the 21st inst., stating experience and salary. A young married man preferred.

FOR SALE

Electric Lighting Plant

Modern Equipment, in good repair, in an Eastern Ontario Town. Street lighting contract and well established paying business, field for expansion. Splendid opportunity for young man. Reason for selling—retirement of member of firm.

Address: LIGHTING PLANT
care of "Canadian Engineer."

The Canadian Engineer

VOL. VIII.—No. 15. TORONTO AND MONTREAL, JULY, 1901. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 1392. **Montreal Telephone,** Main 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	PAGE
Aerial Transmission and Distribution System	346
Beardmore Belting Co.	338
Brass, Melting	339
Conversion from Constant Alternating Potential to Constant Alternating Current	349
Canada and South Africa	330
Centrifugal Pumping	331
Crude Oil Fuel in Iron Works	332
Compressed Air Pressure, Diagram for Calculating	334
Cast Iron, Standardizing Tests of	337
Canadian Electrical Association	341
" Assn. Stationary Engineers	340
Electricity, Young Men in	329
Electrical Standards, Dominion	335
Electric Flashes	352
Incorporations	340
Industrial Notes	351
Mining Matters	354
Nickel, A new Chance for	330
National Association of Master Plumbers and Steamfitters	339
O'Brien Clutch Pulley	iii.
Pan American Exposition	330
Portable Tools, Influence on Workshop Practice	333
Personal	352
Railway Matters	353
Standard Tool Co., Improved Drill Chuck	iii.
Sewage Disposal	354
Superheated Steam	334
Stevens Arms & Tool Company	340
Three Wire Alternating Secondary System, Balancing A	334
Vokes Hardware Co's Tools	351

YOUNG MEN IN ELECTRICITY.

The suggestion made by Mr. Mortimer, at the convention of the Canadian Electrical Association, that a new class of membership be created providing for the admission of students, was a good one, and was promptly acted on by the association. It is one of those cases of hasty legislation which we feel sure will never be regretted. Student membership in the Canadian Society of Civil Engineers is one of the best features of that institution, and the provision to admit worthy young men into the Electrical Association will prove equally successful. It is the best means possible of rejuvenating the blood of such an association, for the student of this year will be the man in business or the man in charge of works or of a central station next year, or at latest, half a decade hence. The student is usually a keen listener, quite as attentive to the business of a convention as the older heads, and the experience of the two or three years of junior membership makes a good school-time in which to develop a useful active member or executive officer of the future. It is a good sign to see the older members of the association so willing to give the young man a chance. This countenance to the young seems to distinguish the electrical fraternity. Prof. F. B. Crocker makes some striking remarks in an article on the predominance of young men in the electrical field. He says that having personally followed the careers of several hundred men, in electricity, he is "convinced that they have gone ahead more rapidly than would have been possible in any other line of human effort." One of the reasons for this is that the industry is so new and has expanded enormously, forcing men ahead. "The other reason is the fact that electricity is a peculiar subject. In its pursuit general intelligence or knowledge is not sufficient for pronounced success. A man possessing special taste for it soon differentiates himself from the others working alongside who may not be endowed with the same advantages. Such a man will forge ahead of his fellows at a rate that is absolutely impossible in any other calling in the world. The successful electrical engineer has more than mere ability. He is gifted with special talent, like the successful artist or the musician. Electricity is, to my mind, the only mechanical pursuit that has 'soul.' The successful electrician is born. Many of the qualities that are his are intangible, just as the fine musician's qualities are. But there must also be tangible qualities, certain fixed mental traits. He must have great mental alertness; the ability to think quickly, to grasp a given situation at once. He must be of an analytical turn of mind—that is, able to reason from cause to effect, or vice versa." He thinks one reason of the progress of young men in electrical work is the willingness to accept new ideas. "It is the first duty of an electrical worker to fall in with rapid advances and radical departures. Therefore, a necessary qualification for the successful electrician is an interest in things that are new because they are new. Anyone with a strong conservative tendency would be at a disadvantage in the electrical field. This is probably the reason why Americans have got along faster than any other nation in the development and use of electricity. An American prefers a thing that is new, whereas a foreigner considers newness in itself an objection." After noticing the preference given to electrical engineers who have graduated from a college or technical school, Professor Crocker remarks: "Of course, success is a somewhat relative term, and it is rather hard to say what proportion of men succeed, as success may be measured in various ways. But it is probably fair to say that nearly all electricians make a very good living within a year or two after they graduate. It is probably a fact that at least half of the men make what can be called a substantial success within three or four years after graduation. I have in mind several young men who have reached prominent positions, and won a national reputation in their profession, within five years after graduation from Columbia University. One of them is chief electrical engineer of the Niagara plant, the largest in the world. Another is professor of electrical engineering in a prominent university. Another became chief engineer of a well known manufacturing company in less than two years after graduation."

A NEW CHANCE FOR NICKEL.

Canada is fortunate in possessing not only the world's chief known supply of nickel, but in having an ore several points higher in commercial value than the supply of New Caledonia, which is the only other commercial competitor we have worth speaking of in the production of this metal. The marvelous qualities it imparts to steel and other metals are well known. It is revolutionizing the art of naval warfare and many of the arts of peace; but with all its remarkable properties, it has two drawbacks; the text books tell us it is not malleable nor ductile. Having as it does such enormous tensile strength and having such power to resist corrosion, it would be a metal still more wonderful than it is if it could be drawn into wire or rolled into sheets. To get such a result the admiralties of Great Britain, the United States, France, Germany, and other countries do not consider the question of price. The question is who can supply them with the material?

Now, this is just what an English correspondent of the Canadian Engineer reports that he has achieved, and he has sent us a sample of the pure nickel wire, drawn to No. 29 Birmingham wire gauge, and another sample of a nickel sheet drawn down to No. 24 gauge. These samples are in our Toronto office for the inspection of any interested persons, and our English correspondent's suggestion that works be established in Canada to supplement the production of nickel matte and so make this country the source of supply of the metal treated by his process, is worthy of early and serious investigation.

Regarding his process, our correspondent says, in reply to an enquiry:

I know the Hans-Frasch process you mention. There are other good processes which accomplish the same results. The point is that after the Hans-Frasch and all these other similar processes have produced practically absolutely pure nickel, what can they do with the said nickel, even when it is rendered pure? The answer to this question is that they can: (a) Alloy the nickel with steel, thus producing nickel steel. (b) Alloy the nickel with copper, thus producing German silver or perhaps cupro nickel. (c) Employ the pure nickel for anodes in electrical matters.

The process which I control, therefore, becomes a powerful adjunct to the Hans-Frasch and all other like processes, because I can take all the pure nickel, which they can produce, and render the same malleable to such an extent that it can be rolled into sheets or drawn into tubes (weldless), and wire of any gauge just the same as is now done with copper or brass. To show you the importance of all this, I may say that pure nickel in England, like that produced by the Hans-Frasch method, is fetching to-day about sixteen pence to eighteen pence per lb. This pure nickel is usually sold in cakes, about one pound weight, or in shot about the size of beans. Now nickel, after being rendered malleable can be sold in the form of ingots, bars, rods, sheets, tubes, wire, and would command in the metal markets a price of three shillings to four shillings and sixpence per pound, according to the gauge reduced to and the tonnage bought. You thus recognize the great commercial advantages which we achieve over these other methods. In plain language, we begin where they have left off, and consequently we help them and create enormous industries and possibilities for their pure nickel, hitherto considered impossible.

CANADA AND SOUTH AFRICA.

Some of our contemporaries objected to the recruiting of the Baden-Powell South African constabulary in Canada, and are now raising an outcry because the Imperial government has sanctioned a state aided scheme of emigration to the South African colonies, without proposing a corresponding scheme for Canada. This is a rather narrow view to take of such matters. The present settlement of the South African difficulty should be for all time and the larger the leaven of loyal British blood the sooner will the Boers realize that they have not only underestimated the might of the British Empire, but have misconceived the character and disposition of the individual Briton. A closer acquaintance as neighbors, with a man from the British Isles or from the British colonies will be a means of educating them as to what true liberty is. They will learn that Paul Kruger's so called republic was at bottom a system of class tyranny, which could not have lasted, and that the equal rights which are the basis of government in British colonies is the only safe foundation of government. Now every Canadian or Australian or other British subject is a missionary in this cause to the Boers, and surely a little temporary advantage to South Africa will not be grudged by Canadians when the security of the key of the Empire in the east is in question. Moreover every Canadian who goes to South Africa is not going to be a loss to this country. Each intelligent Canadian planted in the South African dominions is an advertising agent for Canadian manufacturers, and a living volume of information on Canadian resources and Canadian tolerance of race towards race. Surely even the most mercenary of all these purposes is worth the sacrifice of the few men whose presence there, whether temporary or permanent, will make known the land of the maple leaf to that great sister dominion of South Africa which will rise after the war.

MACHINERY HALL PAN-AMERICAN EXPOSITION.

On June 27th a party of engineers, accompanied by a representative of this journal, left Toronto for a visit to the Pan-American Exposition at Buffalo. The party was made up as follows: A. M. Wickens, executive secretary, C.A.S.E.; W. J. Webb, president C.A.S.E. No. 1; E. J. Philip, M.E., manager the Steam Specialty Co.; Wilson Phillips, manager General Fire Equipment Co.; S. Bulley, proprietor the Planet Cycle Co., Toronto; John Fox and T. M. Morgan.

Machinery Hall and the Electrical Building were the chief objective points. The accompanying cut shows the general lay out of this building, and too much cannot be said of the courtesy shown by the different gentlemen in charge of the exhibits mentioned below. The Cling Surface Mnfg. Co.'s exhibit was of great interest, showing two running belts, taken from the same roll of belting, one treated with Cling Surface, and the other just as it came from the maker. These belts were running from a 10 h.p. Westinghouse motor, two pulleys on a single shaft, to two 5 h.p. Westinghouse generators mounted on trucks arranged to show initial tension and working tension on the belts. The output of each generator is delivered to a bank of one hundred 10-c.p. incandescent lamps. The belt treated with Cling Surface ran very slack, the sides almost touching, under an initial strain of 50 pounds, and lighted its bank of lights brilliantly. The untreated belt ran tight, under an initial tension of about 150 pounds, and only lighted 20 lights brilliantly, and 100 lights a very dull

red. There was also in each circuit a voltmeter and wattmeter, showing the exact output of the individual belts.

The other exhibits visited, either individually or as a party, were the Abendroth & Root Mnfg. Co., boilers, spiral riveted pipe, etc., New York; American Blower Co., Detroit, American Steam Gauge Co., Boston; Brown & Sharpe Mnfg. Co., machinery and machinists' tools, Providence, R.I., to whose exhibit reference was made last month; Buffalo Forge Co., Buffalo, N.Y.; Buffalo Meter Co., water meters, Buffalo, N.Y.; Burr Mnfg. Co., safety blocks, Cleveland, O.; Carborundum Co., Niagara Falls, N.Y., and Niagara Falls, Ont.; Cataract Tool & Optical Co., Buffalo; Chisholm & Moore Mnfg. Co., chain blocks and pneumatic tools, Cleveland, Cyclone Grate Bar Co., Toronto; Diamond Machine Co., grinding machinery, Providence, R.I.; Jenkins Bros., valve manufacturers, New York and Boston; Kieley & Mueller, back pressure valves, New York; Morse Twist Drill Co., New Bedford, Mass.; Standard Tool Co., twist drills, etc., Cleveland. As the time was limited only a short visit could be made to each place, but it was the general verdict of the party that they should again visit the Exposition. Mr. Otis, of the Stewart Heater Co., unfortunately missed connections with the party, but several visited the power house in the northwest corner of the grounds, where the "Otis" heater was in actual service, heating feed water for the battery of boilers which were running the engines in the power plant. From enquiries made these heaters were heating feed water with exhaust steam for 3,000-h.p. to a temperature of 212 Fahr., without any back pressure on the exhaust, and were installed on the 21st of September last. Mr. Haist, of the Keystone Mnfg. Co., 308 314 Terrace, Buffalo, took the party in hand at 4 o'clock and escorted them round the various outside exhibits until their departure at 10.30 p.m. As a host this gentleman could not be excelled, and his previous knowledge of the exhibits and different places of amusement was invaluable. Only for this gentleman one of the most pleasant experiences of the day would have been overlooked, namely a trip to the German village, where Mr. Haist in the mother tongue facilitated progress, and enabled the party to fully explore this very complete model of a village in the Fatherland. The Keystone Co. did not get space for an exhibit, but will welcome any Canadian visitors to their factory.

During the time spent there the party were fortunate enough to hear a lecture by R. L. Gebhard, Louisville, Ky., the vice-president and general manager of the Gebhard Automatic Astronomical Clock Co. This wonderful astronomical clock, of which we are promised a description shortly by Mr Gebhard, is the result of some 35 years of experimenting and very laborious work, and is something which everyone visiting Buffalo should make a point of seeing, as it is a marvelous exhibition of human ingenuity.

While not as large as that of the Paris Exhibition or Chicago, the variety and quality of the engineering and electrical exhibits has not been surpassed on this continent, and now that the machinery is generally in working order the Canadian visitor will not be disappointed in a visit to these buildings. The Canadian building, while not as pretentious as some of its neighbors, reflects credit on Canada, not only by reason of its contents but as an exhibit of architectural design. The building was planned by a Canadian architect, H. C. McBride, of London, Ont., a brother of R. H. McBride, of the Niagara Navigation Co.

Among other firms who have attractive exhibits of interest to Canadian visitors are: The A. A. Griffing Iron Co., Jersey City, N.J. (represented in Canada by the Steam Specialty Co., Toronto), steam appliances; the Lunkenheimer Co., Cincinnati, O., valves, lubricators, injectors, etc.; Wilmarth & Morman Co., Grand Rapids, Mich. (John Lumsden & Co., Montreal, Canadian agents), drill grinders; J. H. Williams & Co., Brooklyn, N.Y., vulcan chain pipe wrenches, special drop forgings, etc.; Builders' Iron Foundry Co., Providence, R.I., water meters, machinery, etc.

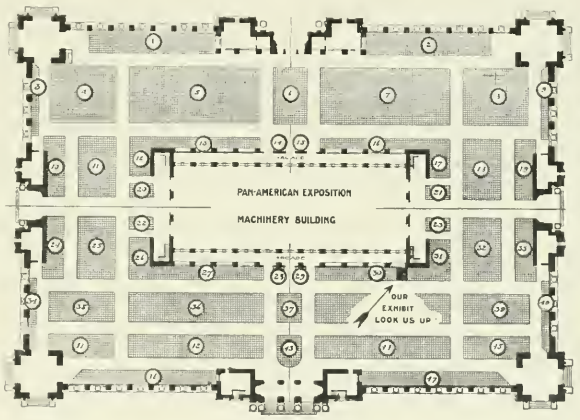


Diagram of Machinery Building, Issued by the Cling-Surface Manufacturing Co.

CENTRIFUGAL PUMPING.

Editor CANADIAN ENGINEER:

Sir,—My former correspondence through the columns of your esteemed journal has been in connection with piston and plunger pumps, and knowing the size of piston or plunger, length of stroke, capacities of the same can be practically arrived at when the speed of the same is accurately taken. Early in the year I had considerable work in connection with a 10-inch centrifugal pump, placed for supplying water in connection with four compound condensing engines for the Merchants Manufacturing Co., St. Henri, Quebec, and would say the conditions do not prevail in its mechanical movement. The characteristic feature of the centrifugal pump is that it is without valves. It is for large quantities of water; as in irrigating, drainage, etc. Its construction is simple, but from the fact that no mathematical calculation can be made in connection with its actual action previous to its construction and operation, and the different forms that have been shown in the various classes of centrifugal pumps have been arrived at by experimenting. Its construction is simple, consisting of a central shaft on which a fan of three blades is screwed or keyed on, and placed in a tight case, with suction and discharge openings. The blades of the fan do not touch the side or top of the case, and when the pump is stopped, if no retaining valve is on the end of the suction pipe, all the water will run back and leave the case empty. Where steam is used to drive the pump an ejector and flap valve is used, and the pump can be readily primed; and, without being filled before starting, pump will not work. But where the means mentioned are not obtainable a retaining valve on the end of the suction pipe is used, and is generally fitted with a bucket. When the pump starts it must be full of

water; the air in the suction pipe and case must be displaced, and every joint critically tight; and when the fan in the case is set in motion, it creates a vacuum within the case, causing the water to enter the suction pipe, and in turn discharged to source arranged, as there are no valves or check to the steady flow of water or other liquid. The pump in question had a vertical suction lift of 8 feet, and discharged its water through 2,300 feet of 14-inch cast-iron pipe, supplying water necessary for four compound condensing engines, one each of 750, 800, 1,000 and 1,100-h.p., and one pump displacing 1,500 gallons per minute for other purposes. The 10-inch centrifugal pump was designed specially for the work. The suction and delivery openings were arranged so that the water had a gradually increasing velocity from the suction to the delivery openings. The speed at which a centrifugal pump should be run is an important consideration in its economical operation. At a slow rate of speed a sufficient vacuum cannot be obtained to raise the water, it is only when a high velocity has been attained that the pump will operate. I found that by increasing the speed I increased the capacity from 4 to 6,000 gallons per minute; this is as might have been expected, and that after the flow had been started the delivery increased, as the four condensor pumps, and one 1,500 gallon pump drew the water away from the centrifugal pump till only 5 pound pressure was at the pump, and by increasing the speed from 235 to 300 revolutions per minute the pump delivered 2,000 gallons more water. Speed and power of motor was increased from 20 to 36-h.p., as taken by indicator from it. It is quite out of the question to calculate the capacity of a centrifugal pump for any rate of speed. In the case alluded to all bends were long and no obstruction allowed to interfere with the flow of water. I have often been asked for a rule giving capacity of a centrifugal pump, and know of none. It depends on shape and construction of fan and case-head, against which they have to work, size of suction and discharge, clearance in volute. For thorough efficiency I consider the Edwards' centrifugal pump the best in every detail. The pump alluded to was driven by a 20-h.p. motor, built by the General Electric Co. On a six weeks' test the motor ran up to 36-h.p., and did splendid work without a hitch.

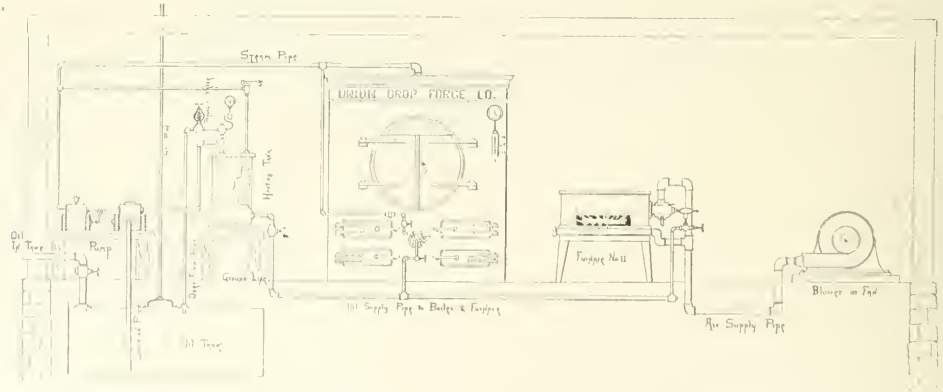
William Perry,
Hydraulic Engineer.

saving in fuel there is a large increase in the amount of work that can be done in the same time, and with the same force of men over coal, and a forging or welding heat can be obtained in fifteen or twenty minutes. The process, also, does away with gas, dirt and smoke, coal space, and the time and trouble in loading up the furnace with coal and carrying away ashes. For use under steam boilers it is far ahead of coal, and also a large saving of labor in more ways than one. It is a direct way of getting best results from oil without going to an expensive process of reducing or making gas through any intermediate method of treatment. It is well adapted for burning brick, tile or any clay or shale products. It makes a regular, even fire, greater uniformity in generating steam for boilers, or heat for forges and furnaces, than with coal.

"The accompanying drawing shows a simple method of connecting the burner under a boiler with steam pressure, also to a forging furnace where a blower or fan is used. The drawing shows the storage tank underground, and in such cases a pump is required, but where plants are so situated that a gravity tank can be used no pump is necessary. The drawing also shows a heating tank, which is only necessary when the weather is cold enough to congeal the oil, which is not often the case. This method of burning oil has been found in every way satisfactory by the largest manufacturing concerns and railroad shops in the United States, and we feel justified in recommending it very strongly, owing to the fact that our plant has been equipped for fifteen years, and has proven so satisfactory that we have never considered making any change for coal; and in plants where there is plenty of space, and where oil is as easy to be obtained as coal, we have found that a saving of from 25 to 50 per cent. is a low average, considering the expense, annoyance and bother involved in the storing and handling of coal, and the carrying away of dirt and ashes."

SUPERHEATED STEAM.

Before the recent convention of the American Society of Mechanical Engineers, E. H. Foster read a paper on the above subject. The author referred to early attempts to use superheated steam and to experimental researches by then Chief



CRUDE OIL FUEL IN IRON WORKS.

The distinctive feature of this system of burning oil for forging, annealing, hardening, or for any purpose in which iron or steel is to be heated, consists in vaporizing the oil with a blast, the arrangement for doing which is complete in the burner itself. The blast is furnished by an ordinary blower or from a pipe direct from the boiler, as shown in drawing. All of the burners use a fan or pressure blower, with about, 1 oz. to 2 oz. pressure, except No. 0 burner which is used with steam, and which is similar in general appearance to No. 10, as shown in cut on page xx. We are indebted to the Union Drop Forge Co., of Chicago, for the following description of the methods: "By this system of burning crude oil, all units of heat are used and turned into work as near as can be made and not stored, so that there is no lost heat. In addition to the

Engineer Isherwood, U. S. N., which demonstrated marked economy from superheat, but which also disclosed practical difficulties which then seemed to be insurmountable. These difficulties arose chiefly from the decomposition of the animal oils then universally used. The introduction of mineral oils and the use of metallic packed stuffing boxes has changed all this, a fact which European engineers have been the first to recognize, and in consequence of which they are now far in advance of ourselves in the use of superheated steam. There are now several thousand successful installations of large and small superheating plants in Europe, and no economical steam plant is there seriously considered without superheaters. The author shows why superheating is economical and gives an outline of European practice. The temperatures used range between 500 and 600 degrees Fahr. A good deal of rivalry exists between the use of cast and wrought iron, as the material for superheaters, but the author favors cast iron

for general use, because of greater durability and greater mass of heated metal which serves to equalize the temperature. He considers, however, that wrought iron has its useful field where lightness and compactness are essential, and where a moderate degree of superheating only is required.

The author inspected cast-iron superheaters which have been in use for six years without trouble or deterioration. He considers that a special field for superheaters is in plants in which steam is conducted from a central boiler plant to engines at a distance, the superheaters in this case being located near the engines. He was unable to obtain any testimony derogatory to the practice, while all testimony agrees that it uniformly results in a gain in economy. He expects the practice to give the triple-expansion engine a set-back, and records a prediction that with the aid of superheat a horse-power will be easily developed from 10 pounds of steam per hour. Records, in fact, already exist of a performance of 10.12 pounds in one 800 horse-power engine.

Mr. Scheffler called attention to the Potts mesh separator, which produced some superheating and in some cases decreased the water in the steam by 60 per cent.

Prof. Goss, being called upon by the president for his experience with superheating in locomotives, said he had no personal experience to relate, but that in the case of two or three German locomotives that had been equipped with superheaters he believed it had been found that there was about the same economy as with compounding, but that there was more or less trouble with the superheater. He thought the papers were good, but that they contained nothing startling. He believed that American engineers had fully appreciated the advantages of superheat, but that they had preferred to get the desired economical results in some other way.

Prof. Storm Bull said that superheating had been neglected in America, and that it might as well be acknowledged.

Chas. G. Y. King related a case of carrying steam through a pipe about 600 feet long in which a superheater in the form of an upright boiler placed near where the steam was used, and fired lightly, had produced very favorable results.

Another member said that where the load varied widely, superheat was a difficult thing to handle, because when the load fell off, the degree of superheat often rose to such a temperature as to make trouble. He had burned out gaskets and even ruined brass valves by steam excessively superheated in this way.

THE INFLUENCE OF PORTABLE TOOLS ON WORK-SHOP PRACTICE.

For more than a generation, we have had at our bidding a faithful servant who performed certain heavy tasks faithfully and well. No one suspected until a very few years ago that this servant was able and willing to perform a multitude of other tasks of a wholly different sort, and with a neatness and promptness heretofore unknown. This useful servant is compressed air. We kept him working in tunnels and mines and quarries, churning down holes to be loaded with explosives, and he set the brakes on our passenger trains. No one thought of taking him into the machine shop and the foundry, the wood-working mill and the stone-cutter's yard and setting him to work there to relieve human muscle. A dozen years or so ago, however, it was found that he could be harnessed to a light hand tool, and made to drive it back and forth a thousand or more times in a minute. Similar tools to give a rotary motion followed close after, and our old servant was fairly established in his new career. At the same time, as most of our readers are aware, a great variety of other new applications of compressed air have been made; but it is doubtful whether any of them compare in industrial importance with its application to portable tools. A large number of these have now been designed and put upon the market, applicable to a very wide range of uses in special industries, and additions to the list are continually being made.

So far, the most important application of these tools has been to displace, or rather to increase the efficiency of the hand workman. The file and the chisel, the chipping hammer and the caulking tool, propelled by the blows of the hand sledge, are fast disappearing. In their place is heard the buzz of the pneumatic tool. These uses of compressed air are now familiar, and the matter to which we want to call attention is the further changes in workshop practice which seem likely to be brought about, and indeed are already appearing through the efficiency of these new portable tools.

In any manufacturing process, a question which must always be decided is whether the work shall be taken to the tool or the tool to the work. In the early days of manufacturing industry, when the use of machinery was in its infancy, and a factory was only an assemblage of workmen using hand tools, and aiding each other through division of labor, it was common practice to take the tools to the work. With the development of automatic machine tools to replace the hand tool in almost every process, it became necessary to reverse this system and take the work of the tool. Where the pieces to be worked were of large size and weight, this involved much difficulty, and in the olden times large expenditure of human muscle. It is not so long ago since the only equipment of a machine shop or foundry to handle the materials worked upon consisted of block and tackle or clumsy jib cranes, all worked by "main strength." We need hardly say that compressed air and electricity have changed all that. No modern manufactory doing heavy work is equipped for economicial production without an outfit of pneumatic hoists and electric cranes, and this is often supplemented with something in the way of a general conveying system, perhaps in the shape of a shop railway operated by electric power.

These devices perform admirable service, and in many cases their use will be permanent. There are other cases, however, where the development of portable tools is likely to cause a return to the former practice. Instead of taking the work to the tool, it will again become common to take the tool to the work. It will be of interest to note some practical illustrations. One which has already become common and is familiar to most of our readers is the operation of riveting. The first power riveters (some of them still in use for places where a deep gap is essential), were ponderous machines, fixed in place, operated by hydraulic or steam pressure, and the work was, of course, brought to them. For every rivet driven, the heavy plate or boiler or whatever was in hand had to be swung to just the right position for the jaws to close down on the hot rivet. As we have remarked, such machines are still in use for work where a deep gap between the jaws of a machine is essential; but for all ordinary work, the light portable pneumatic riveter which is taken to the work can be operated much more rapidly.

An illustration of more recent date occurs in foundry practice. The foundry is the department of machine construction where hand tools and hand work have longest retained their sway. It is only within the past dozen years that machine molding has come to have an important place in foundry work. With machine molding, however, an important change in the foundry system became necessary. The molding machine is a fixed machine, and the work had to be brought to it. That is to say, the machine had to be kept supplied with empty flasks and sand, and the completed flasks had to be carried off to the pouring floor. Thus some system of mechanical conveying frequently became a necessity to supplement the molding machine and enable it to work up to its capacity. These conveying systems often cost more to build and to operate than the molding machine itself. As those of our readers familiar with foundry work are aware, the chief work done by a molding machine is to ram or pack the sand in the flask. Recently portable pneumatic rammers have been developed, which in many places are claimed to do as good and more rapid work than the fixed molding machines. The tool is taken to the work again, instead of the work to the tool. The flask is filled and rammed on the pouring floor, just as was done in the foundry before the introduction of molding machines, and the conveying of sand and flasks from the pouring floor to the machine and back to the floor again is no longer necessary.

Of course, there are classes of work where the fixed molding machine will still prove superior. There are others where the portable rammer will be a far more economical tool. It is the business of the managers to select the equipment best suited to their special conditions.

In general, it will be evident that the portable tools will be of undoubted superiority on large and heavy work. The fixed machines will be equally certain of preference in shops

where small repetition work is the chief output. The changes in workshop practice, which we are discussing, therefore, will not affect the manufacturer of small articles. The workshops where such changes will take place are those where huge and heavy things are made—the boiler shops, the bridge works, the ship yards, the builders of heavy machinery. Here portable tools are already found in large numbers, and new fields for their profitable employment are all the time appearing.

We have thus far spoken chiefly of compressed air in connection with the development of portable tools, although electric power has also played some part in this work. The electric motor has the very considerable advantage for use in a portable tool that its supply of energy is derived from a flexible cable instead of a flexible hose, and it can be used, therefore, with a longer range from a fixed point and with less expense and difficulty in power distribution than compressed air. This advantage of electricity, however, is more than offset by the fact that electricity requires considerably more weight in the tool itself to give an equal blow or an equal torque with the compressed air tool, and this seriously interferes with the portability and rapid use of the electric tool. Besides this, small sizes of electric motors are so inefficient in use of current as to heat rapidly and become inconvenient to handle. Nevertheless, for special purposes, electricity may at times be the superior; and its possibilities should not be overlooked by designers and users of portable tools.—Engineering News.

DIAGRAM FOR CALCULATING COMPRESSED AIR PRESSURE.

The graphic table, herewith presented, is intended to facilitate calculations in power transmission by compressed air. Any problem within the limits of the table can be solved by a glance without reference to the usual intricate formulas. The table is spaced on a logarithmic scale, thus giving, at the same time, large range of values, with accuracy in smaller quantities. Horizontal lines show loss of pressure in pounds per 100 feet of pipe, and vertical lines show cubic feet of free air per minute. A single example will suffice to show the manner of using the table:

Example: It is required to operate ten drills using 1,000 feet free air per minute at a distance of 6,000 feet from the compressor. The air is transmitted through 5-in. pipe. What additional pressure will be required at the compressor to give 75 pounds terminal gauge pressure?

Referring to the diagram, take the vertical line denoting 1,000 cubic feet free air per minute, follow it up to intersection with curved line representing 5-in. pipe; note the horizontal line at the same intersection, which denotes .10 pound which is the additional pressure required for 100 feet of pipe; hence

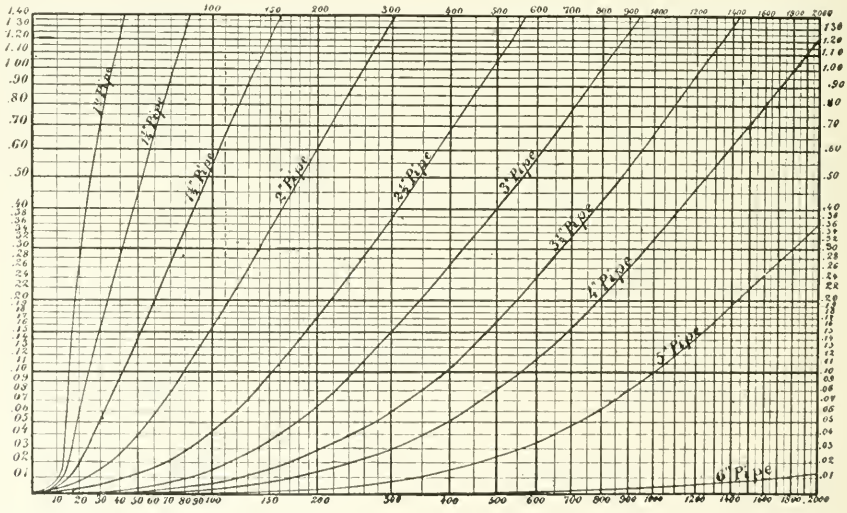
$$\frac{.10 \times 6{,}000}{100} = 6 \text{ pounds, and } 75 \text{ pounds} + 6 \text{ pounds} = 81 \text{ pounds,}$$

the gauge pressure required at the compressor.

If the air is to be transmitted through 4-in. pipe, we have:

$$\frac{.32 \times 6{,}000}{100} = 19.2 \text{ pounds, and } 75 \text{ pounds} + 19.2 \text{ pounds} = 94.2$$

pounds, the compressor gauge pressure required.—Mining and Scientific Press.



BALANCING A THREE-WIRE ALTERNATING SECONDARY SYSTEM.*

BY L. DENIS, QUEBEC CITY.

Poor distributing regulation is a very common and even accepted occurrence amongst central stations; and this, if not properly checked, may very likely be the cause of a retardation in the electrical progress. In this paper it is intended to give a short description of the method employed by the Jacques Cartier Water Power Company, of Quebec, for keeping a three-wire secondary network in proper balance. Before entering into the subject of secondary distribution proper, kindly allow a short description of the whole distributing system. As in most distribution of any size, the city is divided into several districts, fed by separate single phase primary feeders (the power distribution being quite separate from the lighting). In each of these districts is a main bank of transformers connected to feed a three-wire distribution (108 volts on each side). These transformers are separated from one another by properly fused junction boxes in the two outside secondary wires and set midway (electrically) between transformers. The primary feeders are regulated by means of Stillwell regulators from direct pressure readings taken at different points of each of the banks and carried back to the station by pressure or pilot wires, which are strung in the form of a cable and which show the pressure across the two outside wires on a 200-volt volt meter, which takes a current of only .006 of an ampere. The neutral wire is also carried back to the station in the same cables and arranged on a switch so that the readings on each side of the three-wire system may also be obtained on a standard voltmeter. The outlying districts are fed from independent transformers, with which we are not concerned in this paper. Coming now to the subject proper and considering an individual consumer—it is essential to know three facts about him before any attempt is made at keeping records:

*Paper read before the Canadian Electrical Association.

1. What side of the secondary circuit the connection is made on.

2. What transformer in the bank the connection is made on.

3. What his approximate maximum demand will be.

Knowing these for each consumer, it is quite simple to arrive at the maximum demand on each side of every transformer, and a record thereof may be kept. The method employed by the above-named company to ascertain these three facts is as follows: For each consumer to be connected, a form is filled out giving the name and address of consumer; from his address the transformer he will be fed from, is determined and put down, and by referring to records for this transformer, the best side to put consumer on is also determined and put down. The slip thus filled out is handed to the foreman of a service connection gang, who has to go by it in running the service wires, and returns it to the office as soon as he is through. If, however, for some reason or another, he finds it impossible to follow the slip to the letter, he is instructed to make whatever alterations are necessary, so that when the slip is handed back it shows the actual manner in which the consumer has been connected. Now, going into further details about the three points above enumerated, little need be said about the first, except describing the manner in which one side of the secondary system is distinguished from the other. The three wires are strung on a four-pin crossarm, using three consecutive pins, the same relative position being maintained all along the bank. This construction will give you at each pole the same two wires (one outside and the neutral) separated by the pole and the other two (the other outside and the neutral), with nothing between. These two sides may be designated as "a" and "b," or "1" and "2," or any other convenient symbols respectively. It is evident that great care must be taken in running three wire taps from a main line not to have circuit "a" of your tap connected on circuit "b" of the line and circuit "b" of tap on "a" of line, as this is certain to give rise to very serious errors. To determine the second point, maps of the different districts of the city are maintained and kept up-to-date, as far as changes on the lines are concerned. These maps show the secondary line and taps, and the exact position of transformers, and junction boxes. Knowing a consumer's address, his exact location is ascertained with the help of a city directory and the transformer feeding the nearest mains determined. The transformers are distinguished from one another by numbers painted on them after they are tested. The transformers are numbered in the order they come through, irrespective of size or the bank in which they are to be inserted. The only difficulty to be encountered in connection with this second point happens when a new transformer is set up to reinforce the bank. When it is found from the records that a transformer in the bank is being overloaded, which really only means that the demand per unit length is becoming greater in that part of the bank, it becomes necessary to have the transformers at that point nearer one another, which means that another transformer has to be inserted, and possibly the existing ones moved. To get at the best position for this new transformer, what may be termed "trial records" are made out from the original connection slips belonging to the transformer or transformers to be relieved, by placing the new transformer and its junction boxes in different imaginary positions on the map, choosing the position which gives the best results on these "trial records." These "trial records," although very nearly correct, cannot be relied upon as absolutely accurate, and an inspection of the line has to be made after all changes are completed to determine exactly what customers have been changed from one transformer to the other, and of course records changed accordingly. The third and possibly most important point may at first sight seem very hard to determine with any degree of accuracy, but if proper judgment be used in establishing certain factors for different classes of consumers dealt with, maximum demand may easily be determined. The factors used by the Jacques Cartier Water Power Company are governed mainly by the rate under which a consumer contracts, but in some cases also by the class of consumer to be served. For ordinary meter consumers (residences and stores of moderate size), 40 per cent of the total installation is taken as a maximum demand; for the larger stores and manufacturers individual factors are assigned, which generally vary from 75 per cent. to 90 per cent. of total installation. For consumers on the flat rate, 90 per cent. of total capacity contracted for is taken. Consumers on limited capacity system are the most easily dealt with, as naturally the maximum demand contracted for must be taken as their maximum demand without introducing any factor whatsoever.

A few figures may be of interest to show a comparison between the actual maximum demand as read on distributing switchboard meters and the total maximum demand as estimated in the manner described above for the corresponding circuit:

Max. Dem. in lamps from switchboard meters.	Estimated max. demand.	Per cent. of actual on estimated.
1,840	2,206	83
3,200	4,272	75
1,320	1,767	75

As figures show that the "actual" and "estimated" bear approximately the same ratio to one another in different districts, all the more will they do so on different transformers and on the two sides of the same transformer, for the factors above referred to will actually tend to be more alike in one part of the district than in different districts. So that as far as balancing is concerned, the estimated figures may be relied upon with absolute confidence. Another proof of at least the approximate accuracy of figures arrived at by estimate may be obtained from the fact that in spite of the very rapid growth of the plant (over 30,000 lamps of 16-c.p. having been connected in about one year), and having been guided entirely by this estimated maximum demand in all changes and additions to city distribution, not one case of burnt-out transformer from overload has occurred, and only three cases of blown fuses. It is hoped that the contents of this short paper will go towards removing some of the objections to an alternating three-wire secondary system.

DOMINION ELECTRICAL STANDARDS.

Among the papers read at the electrical convention at Ottawa was an instructive one by Ormond Higman, chief of the electrical testing laboratory of the Dominion government. When the Electrical Units Act was passed at Ottawa in 1894, Mr. Higman was instructed to procure apparatus by which to establish standards. In doing this he reviewed the work of the Committee on Electrical Standards appointed by the British Association in the seventies, and that of the Electrical Standard Committee of the British Board of Trade in its report of 1892. The work of these committees changed experimental electricity into an exact science, but there were still lacking instruments by which these standards could be applied to practical every day work, and whose accuracy could not be questioned. For the measurement of current and electro-motive force, both varying and unvarying, Lord Kelvin's instruments were recommended. The following apparatus has been procured by the department as standards of electrical measure, and although not complete, Mr. Higman states that good progress has been made in complying with section 3 of the Units Act.

Standards of Resistance.

Three standard ohms, two of the Board of Trade and one of the Reichsanstalt (Berlin) pattern. One resistance box containing ten 1-ohm coils with suitable plugging arrangements for putting the coils in series as a 10-ohm standard or in multiple as a 1-10-ohm standard. One Kelvin resistance coil 100,000 ohms with 10 sub-divisions of 10,000 ohms each arranged with plugs for connecting in series or in parallel or any combination of series and parallel. One Wheatstone Bridge (Anthony pattern) with ratio coils, 1, 10, 100, 1,000 and 10,000 on each side with bridge coils of tenths, units, tens, hundreds and thousands. These coils are made of manganin specially selected and the box is fitted with an electric thermometer. Measurements of great accuracy can be obtained with this bridge used in conjunction with a sensitive reflecting Darsonval galvanometer. Intercomparisons between these standards will be made from time to time and records kept of their variations.

Measurement of Current.

For the measurement of current a set of Lord Kelvin's balances has been provided, covering the following ranges: 0 to 1 ampere, 1 to 5 ampere, 5 to 25 ampere, 25 to 125 ampere, 1 Watt balance, 100 amperes and 200 volts. These instruments are founded on the mutual forces, discovered by Ampere, between movable and fixed portions of an electric circuit. The shape chosen for the mutually influencing portions is circular and are called by Lord Kelvin "Ampere Rings." In each of the instruments each movable ring is actuated by two fixed rings, all three approximately horizontal. There are two such groups of three rings—two movable rings attached to the two ends of a horizontal balance arm pulled, one up and the other down by a pair of fixed rings in its neighborhood. The current is in opposite directions in the movable rings so practically annul disturbance due to horizontal components of terrestrial or local magnetic forces. It is fortunate that these magnetic disturbances have been thus annulled for reasons that will be alluded to presently. In all of the balances the current goes in opposite directions through the two fixed rings, so that the movable ring is attracted by one of the fixed rings and repelled by the other. The balances were constructed specially for the department and are a modification of the ordinary type. They are intended as ultimate standards, great accuracy and permanency being guaranteed. The scale and sliding weights are taken away and the beam is made specially strong and has a pointer at each end. A scale pan is hung at each end of the beam, and the distance from coil to coil is greater than in the ordinary balance. The method of making an observation is by placing a weight of fixed amount on the left-hand scale pan, and the beam is balanced with no current through the coils; the weight is then lifted to the right-hand scale pan and the current turned on. The amount of current passing is adjusted till the beam again balances, when the current will be according to the value of the weight used. Tests having an accuracy of 1-20 of one per cent. can be quickly made, and with more careful manipulation a much higher degree of accuracy can be attained. For purposes of graduation or standardization, the silver voltameter is used. It is one of the most accurate methods for calibrating current measuring instruments. It depends on the well-known principle that when a current of electricity flows through an electrolyte, the amount of decomposition resulting in a given time is directly proportional to the total quantity of electricity which has passed in that time. For any substance 1 coulomb will always decompose or liberate at the cathode the same fixed weight of the substance and is defined as its electro-chemical equivalent. The latest experiments agree in giving 0.001118 as the electro-chemical equivalent of silver. The specification for the electrolyte is given in schedule B. A more convenient, if not quite as accurate a method is the copper cell. The experimenter should be careful to procure pure copper sulphate and plates and the use of a chemical balance. A small quantity of sulphuric acid will improve the electrolyte. The electro chemical equivalent of copper is 0.00237, or 1.177 grammes of copper are deposited per ampere-hour, approximately. Another method for the measurement of current and the standardization of instruments is the fall of potential or potentiometer method. The department is now installing one of Crompton's laboratory instruments of this type, made expressly to order and suitable for reproducing and comparing standards with the highest possible degree of accuracy. Standard resistances of the following capacity are furnished with the instrument for current measurement:

Resistance in ohms.	Maximum current in amperes.
1.	1.5
.5	3
1	15.
.01	150.
.005	300.

These resistances consist of a sheet or strip of metal, or a coil of wire, each provided with 4 terminals, 2 for connection to the circuit and 2 for connection to the potential leads. The resistances are made of manganin and owing to the exceeding low temperature coefficient of the alloy, no temperature correction is necessary except for inaccuracies exceeding 1 part in 1,000 when a curve giving the temperature value of the whole range of current that the instrument is capable of carrying is supplied. The current to be measured is passed through one of these standard resistances and the fall of potential noted. If the resistance standards are properly proportioned to the instrument, the reading in amperes will be direct. Thus a standard carrying 1,500 amperes should cause a fall of 1.5 volts, each section of the instrument being equivalent to 1-10 of a volt will therefore correspond to 100 amperes. The accuracy of the apparatus for current measurement, as will be observed, is largely dependent on the accuracy with which the standard resistances are constructed.

Another method for the measurement of current by the fall of potential is that known as the "Vienna Method." A set of instruments comprising a Weston milli-voltmeter and shunt box have been procured and forms one of the most flexible, and at the same time, accurate means of current measurement. In this as in the preceding method, if the resistances are proportional to the voltmeter, the reading in amperes will be direct. The resistances in the shunt box are made of manganin alloy with practically no temperature variation and are correct to 1-5 of 1 per cent. The combination gives three full scale readings as follows: From 0 to 1.5 amperes, from 0 to 15 amperes and from 0 to 150 amperes. Tests can be made with great rapidity and readings on each scale from a small fraction of an ampere up to the maximum can be had in the space of two or three minutes.

Measurement of Electro-Motive Force.

Primary Standards.—Two standard Clark cells; three Hibbard 1-volt cells and a set of six special standard multicellular electrostatic voltmeters by Lord Kelvin. The latter covers a range of from 20 to 3,200 volts and was specially constructed for the department as ultimate standards of E.M.F., great accuracy and permanency being guaranteed. During the two years since the instruments were first installed, the variation in the calibrating curves has been less than 1 part in 10,000. These instruments have the great advantage of being equally accurate on direct or alternating circuits. Being electrostatic, they use no current and are unaffected by local magnetic conditions. They can be kept continuously in circuit and require no temperature correction. The instruments are calibrated by comparison with the difference of potential between the terminals of a known resistance through which the current is being measured by means of a Kelvin standard centi-ampere balance or by the potentiometer method. Intercomparisons with the standard E.M.F. cells will be periodically made, and all variations recorded. The specification for the standard Clarke cell will be found in schedule C.

The Potentimeter.—This excellent piece of laboratory apparatus and its adjuncts, though equally applicable to the measurement of current and resistance more properly comes under the head of E.M.F. standards for treatment. The fall of potential method of making measurements originated with Poggendorf, but the credit for developing the system from a crude workshop method up to what may fairly be described as a scientific instrument of no mean calibre, mainly belongs to R. E. Crompton, of London. Measurements from the lowest to the highest value may be taken by direct comparison with the legal standard, to well within 1-10 of 1 per cent. under ordinary circumstances, whilst, by special care, a far higher degree of accuracy may be attained. The form of instrument now being furnished the department by the Messrs. Crompton, may be said to consist of 15 sections of wire connected in series, 14 of which are in the form of coils within the instrument, the 15th being stretched along a scale suitably divided; they are accurately adjusted with each other, so that with a fixed E.M.F. of 1.5 volts over the whole each section has a fall of 1-10 of a volt, the scale beneath the slide wire having 1,000 divisions each, corresponding therefore, to 1-10,000 of a volt. The unknown quantity to be measured is placed in series with a galvanometer attached to the movable contacts on the slide wire and is so connected up that its E.M.F. opposes that of the main circuit of the instrument. No deflection of the galvanometer takes place when the point of balance between the opposing E.M.F.'s is obtained. The value of the comparison is then read from the scale. The instrument is calibrated by substituting for X a known value or standard—in this case a standard Clarke's cell—its temperature noted, and the contacts on the slide wire placed upon the figures corresponding with the value of the cell which would be 1.431 or 14 and 34. Resistance is added in the main circuit until there is no deflection on the galvanometer due to

the fact of the E.M.F.'s in the main and galvanometer circuits being equal; the instrument is thus standardized from what afterwards becomes the X circuit and is then ready for obtaining the value of the unknown E.M.F.'s. Multiples and submultiples of the ohm are used to vary the range of the instrument. They are so proportioned that their maximum carrying capacity is some definite value proportional to that of the instrument (1.5 volts) and it is entirely upon them that the range of the apparatus depends. Given proper standard resistances, the range of the instrument is practically illimitable. Weston standard voltmeters are used as secondary standards of E.M.F., both for direct and alternating current. One of these, for alternating current work, was specially made for our laboratory, and has its coils and working parts immersed in oil, thus making it absolutely "dead beat" in its operation. It is supplied with a differential scale giving readings to 1-5 volt. These voltmeters are furnished with multipliers giving ranges from 0 to 1,500 volts, and accurate to within 1-10 of 1 per cent.

Measurement of Electrical Energy.

One Standard Kelvin Watt Balance.—This balance is intended to measure the true energy developed in an inductive alternating current circuit. It is similar in form to the Ampere Balances, but the movable coils are wound with fine wire. These coils are of low resistance and are joined up in series with a large non-inductive resistance in a potential circuit across the mains, while the fixed coils carry the whole current to be measured. Three sets of weights are supplied with the instruments, weighing respectively 1.7564 grms., 4.3910 grms. and 17.5640 grms. The constant for each set of weights with 1.000 ohms in the fine wire circuit is 2 watts, 5 watts and 20 watts per division of the scale. The constants vary directly as the resistance in the fine wire circuit. This instrument has proven to be an excellent standard having been in constant use for four years with absolutely no change in its accuracy. Secondary Watt Standards in use by the departmental officers are those of the Weston and Hoyt types.

Accessories.

As accessories to these standards, it may be stated that two alternators are being installed, and these will be operated from storage batteries, thus ensuring a constant E.M.F. One of these is a three-phase, 60-cycle machine, and the other a single-phase, 130-cycle machine. Both are nominally 104-volt alternators but are capable of wide ranges of variation, both in respect of voltage and frequency. Direct current measurement is made from the storage battery. As a source of E.M.F., Mr. Higman prepared 300 secondary cells, giving a range of from 2 to 650 volts. Very satisfactory comparisons can be made with the absolutely steady pressure from these cells.

Photometeric Measurement of Light.

The Bunsen Photometer is used throughout the Dominion by the officers of the department. This piece of apparatus is so well known that a lengthy explanation of it before this association would be quite unnecessary. It is known as the grease spot method and consists mainly of a wooden movable frame over which a piece of white paper is fixed with a grease spot in the centre. The two sources of light to be compared shine on either side of the disc and the practical value of the light to be measured is determined by the total brightness which that light is capable of producing on the disc when compared with the total brightness which the unit candle is capable of producing on the same surface. In order that both sides of the disc may be read simultaneously, a system of mirrors, introduced by Rudorff, is used. The sliding carriage containing this arrangement of disc and mirrors is moved along the scale until it reaches a point where the spot entirely disappears. The candle-power of the light being measured is then obtained by dividing the square of the distance of the source of light from the screen by the square of the distance of the standard candle from the screen. Notwithstanding the fact that the sperm candle is not a first-class standard, fairly accurate work can be done with it. The incandescent lamp is now more or less used as a secondary standard for the practical measurement of light, but the system is dependent on too many conditions being fulfilled to be accepted with any degree of confidence. Sir William Preece, among a number of others, considered that an incandescent lamp of a given type, coming from the same maker, present only insignificant differences among themselves with respect to luminous intensity and efficiency, and he was of opinion that a very convenient standard of this kind sufficiently exact for most purposes might be obtained. The subject of photometery and light standards is, however, a very large one and had better be reserved for treatment on some future occasion.

In conclusion Mr. Higman says the room at present occupied in the Inland Revenue Department is altogether unsuited for the purpose. The flooring above and below is laid on iron joists, and these are supported by massive iron girders and columns. If the magnetic conditions surrounding these masses of iron were constant and unchanging, the errors due to their presence might, in a large measure, be compensated for; but unfortunately, live wires run over and along these girders, and the generating units are operated in their midst, rendering at once a condition of affairs anything but harmonious in so far as the use of delicate and sensitive instruments are concerned. Fortunately the Kelvin standards for current and E.M.F. are not affected by local magnetic conditions, but the sensitive galvanometers are very seriously affected and accurate work with such instruments is almost, if not quite an impossibility.

STANDARDIZING TESTS OF CAST IRON.

At the recent convention of the American Foundrymen's Association, the committee on standardizing the testing of cast iron made a valuable report, of which the following is a summary:

There are two methods of judging the physical quality of castings; 1. In the abstract—judging the quality of the iron entering into them; this leaves out the elements of uncertainty introduced by the things which happen after pouring. 2. In particular—the quality of the casting for the purpose intended. This can only be ascertained by testing the casting itself, or at least the representatives of a given lot. This latter method, of greatest importance to the buying element, will likely always be studied and specified by them, and cannot, therefore, be well taken up by our foundrymen on the initiative. Car wheels, car couplers, boiler castings, pipe, etc., are among the numerous things now bought regularly under specifications which ensure good results, the tests being made on the casting themselves. As these particular instances, however, will always remain the great minority of the foundry product, the method of testing which will most concern us is that which judges the iron entering into the molds.

Cast iron, so far as its availability for various classes of castings is concerned, depends upon a given chemical composition and a physical constitution dependent also upon the nature of the mixture and the heat treatment. That is, once the chemical composition best suited for the work is determined upon, there still come in the effects of the kind of pig iron used, the proportion of pig iron to remelted material, the steel and other additions, the melting process used, and the kind of molds poured into.

We have differentiated the various classes of iron into all pig, and pig and scrap mixtures. Then again into cupola and furnace irons, warm and cold blast charcoal, coke and mixed charges. Finally in an arrangement which divides the classes by their chemical constituents. Table 1 shows this more clearly:

Series.	Class of Iron.	Melted in.	Pig Iron Used.	Size of Heat Tons.	Si.	P.	S.
A	Ingot Mould	Cupola	Coke	60	1.07	*0.045	0.032
B	Dynamo Frame	Cupola	Coke and charcoal	60	1.95	0.405	0.042
C	Light Machinery	Cupola	Coke and charcoal	40	2.04	0.578	0.044
D	Chilled Roll	Air Furnace	Cold Blast charcoal	30	0.85	0.482	0.07
E	Sand Roll	Air Furnace	Warm blast charcoal	30	0.72	0.454	0.07
F†	Sash Weight	Cupola	Coke and charcoal	15	0.91	0.441	0.218
G	Car Wheel	Cupola	Charcoal and coke	10	0.97	0.301	0.00
H	Stove Plate	Cupola	Coke	20	3.19	1.160	0.84
I	Heavy Machinery	Cupola	Coke	30	1.96	0.522	0.[illegible]
J	Cylinder	Cupola	Coke	10	2.49	0.839	0.084
K	Novelty	Cupola	Coke	5	4.19	1.236	0.80
L	Gun Metal	O. H. Furnace	Coke and charcoal	10	2.32	0.670	0.44

*All pig iron.
†Nearly all burnt scrap originally from charcoal and coke irons.

Throughout the whole line of operations only regularly constituted mixtures were used, the balance of the heats from which these test bars were cast going directly into commercial castings of the classes designated. The results are, therefore, entirely comparable with daily practice, and are not exceptional cases prepared specially for a good showing. For purposes of comparison, green sand and dry sand bars were made, side by side, even though the iron in practice goes into only one of these classes of molds. It was felt that comparison records were wanted just as much as specifications for the separate lines of product. For this reason, also, we recommend one standard size of test bar for comparative purposes only, each class of iron being given its special treatment for the information wanted in daily practice in addition.

Our studies on the shape of the test bar have resulted in the selection of the round form of cross section, and this mainly on the score of greatest uniformity in physical structure, the corners of the square bar introducing elements which become troublesome, especially in irons with a lower range of the silicon contents.

The following are the sizes of bars selected for tests, as a result of our investigations:

For all tensile tests a bar turned to 0.8 inches in diameter, corresponding to a cross section of ½ square inch. Results, therefore, multiplied by two, give the tensile strength of per square inch. For transverse test of all classes of iron for general comparison, a bar 1½ inches in diameter on supports 12 inches apart, pressure applied in middle and deflection noted. Similarly for ingot mold, light machinery, stove plate and novelty iron a 1½ inch diameter bar—that is to say, for irons running from 2 per cent. in silicon upward or from 1.75 per cent. silicon upward, where but little scrap is in the mixture. For dynamo frame, sash weight, cylinder, heavy machinery and gun metal irons, similarly a 2-inch diameter bar is recommended—that is, for irons running from 1.50 to 2 per cent. in silicon, or where the silicon is lower and the proportion of scrap is rather large. For roll irons, whether chilled or sand, and car wheel metals, a 2½-inch diameter bar is recommended—that is, for all irons below 1 per cent. silicon, and which may therefore be classed as the chilling irons.

PROPOSED STANDARD SPECIFICATIONS FOR GRAY IRON CASTINGS.

1. Unless furnace iron, dry sand or loam molding, or subsequent annealing is specified, all gray iron castings are understood to be of cupola metal; mixtures, molds, and methods of preparation to be fixed by the founder to secure the results by purchaser.

2. All castings shall be clean, free from flaws, cracks and excessive shrinkage. They shall conform in other respects to whatever points may be specially agreed upon.

3. When the castings themselves are to be tested to destruction, the number selected from a given lot and the tests they shall be subjected to are made a matter of special agreement between the founder and purchaser.

4 Castings made under these specifications, the iron in which is to be tested for its quality, shall be represented by at least three test bars cast from the same heat.

5. These test bars shall be subjected to a transverse breaking test, the load applied at the middle with supports 12 inches apart. The breaking load and deflection shall be agreed upon specially on placing the contract, and two of these bars shall meet the requirements.

6. A tensile strength test may be added, in which case at least three bars for this purpose shall be cast with the others in the same molds respectively. The ultimate strength shall also be agreed upon specially before placing the contract, and two of the bars shall meet the requirements.

7. The dimensions of the test bars shall be as given herewith. There is only one size for the tensile bar and three for the transverse. For the light and medium weight castings the 1½-inch D bar is to be used, heavy castings the 2-inch D and chilling irons the 2½ inch D test bar.

8. Where the chemical composition of the castings is a matter of specification, in addition to the physical tests, borings shall be taken from all the test bars made, well mixed and any required determination, combined carbon and graphite alone excepted, made therefrom.

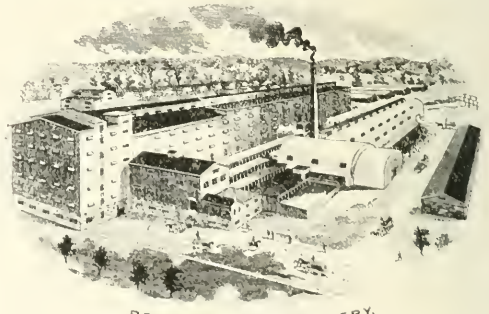
9. Reasonable facilities shall be given the inspectors to satisfy themselves that castings are being made in accordance with specifications, and, if possible, tests shall be made at the place of production prior to shipments.

WM. J. WEBB.

Wm. J. Webb, who has been elected president of the pioneer Toronto branch of the Canadian Association of Stationary Engineers, is chief engineer of the Lawlor estate buildings. He has taken great interest in the association and the election is a popular one.

A MODERN BELTING FACTORY.

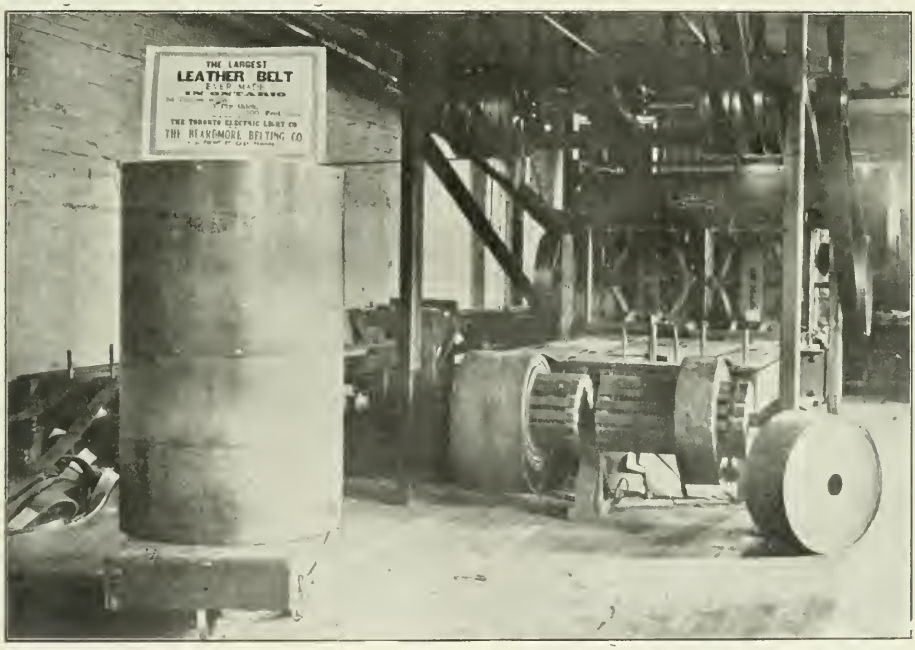
It was only eight years ago that the Beardmore Belting Company started in the leather belting trade in a modest way, but they have increased their business steadily each year, until now with offices in Toronto and Montreal, they have won an acknowledged position in this specialty. Their Acton, Ont., tannery, here illustrated, employs several hundred hands, and together with the glove works, is practically the sole support of the town and neighborhood of Acton. The firm's success seems to be due to three good causes: They installed machinery and plant of the very latest build and the highest efficiency for economical manufacturing, much of it being specially designed machinery, unique in the leather belting manufacture. Their great stock and turnover of hides, amounting to some thousand sides a day, gives them an advantage of choice of leather for special uses, which ordinary manufacturers, who buy their butts in the open market, cannot command. And lastly, prompt business methods, combined with excellent quality of material, have gained for the firm the



BELTING LEATHER TANNERY, ACTON WEST, ONT.

confidence of the manufacturing buyers of belting. As an example of the facility to deal with unexpected demands we may recall the disastrous fire which occurred in the Electric Light Co.'s power houses in London, Ont., in September, 1899. The Beardmore Belting Company received the order to replace the belts destroyed early in the morning after the fire. That afternoon men and materials were despatched to London, and the same evening the electric light was in use again; a record of promptness that few firms could equal. Again, when during the recent disastrous Board of Trade fire in Montreal the firm's premises and stock were destroyed, new premises in Lemoine street were procured and restocked from Toronto with a complete equipment within 48 hours.

The company use in the belting manufacture only the choicest packer steer hides, and the usual complaints as to stretching, which entail lacing and re-lacing, are overcome in a great degree by a thorough system of stretching. The size of their works, and the quantity of their stock, facilitating proper and effective treatment. As a consequence of this good judgment the Beardmore Belting Company have supplied some of the largest leather belts in Canada, which, after being years in use, are still giving the best results. The Toronto Electric Light Company have in use five 54-in. and one 60-in., all 3-ply beltings, and have an order now placed with the same firm for two 54-in. of about 100 feet in length. The Cataract Power Company, on their long transmission line, have three 36-in. double ply; and the Metropolitan Electric Railway, in their power house at Bond Lake, use two 42-in. belts. In the assembling of these belts the firm make use of the Star brand rivets, their trade mark being also the "Star Brand." Amongst the goods supplied by this firm we note lace leathers, Goodyear welting, flat, twist and round belting. They are also agents for the O. C. Little Electric Pulley Coating,



Menasha, Wis., which they claim is the only coating that oil or water will not penetrate or injure. Two diplomas have been awarded to the firm as belting manufacturers, exhibiting the product which has been manufactured from the hide to the finished belt in their own works. The Beardmore Belting Company were the first company in Canada to do their own tanning and manufacturing, and have inaugurated a new era in this trade in Canada, whereby their goods are passed direct to the users without going through the hands of middlemen. A telegraph code has been recently issued by the firm for the convenience of their clients, and owing to the large stock carried, special demands can be met with prompt delivery.

THE NATIONAL ASSOCIATION OF MASTER PLUMBERS AND STEAMFITTERS.

The National Association of Master Plumbers and Steamfitters held their sixth annual convention in the Temple building, Toronto, on the 26th, 27th, and 28th ult., under the presidency of W. H. Meredith, of Toronto. The delegates were welcomed to the city by Aldermen F. Strachan Cox and Loudon, on behalf of the Civic Reception Committee, and were greeted by local associations and manufacturers.

The president, in his annual address, reported all branches of the business to be in a flourishing condition; but advocated local branches in country towns and districts where sanitation was neglected and work not subject to inspection, or inefficiently done. An important movement sanctioned by the executive committee at this meeting was the formation of provincial associations, Nova Scotia, Cape Breton and Prince Edward Island for this purpose being counted as one province, while Manitoba and the North-West Territories are also jointly represented. The provincial associations will be composed of local members, whose representatives will form the national association and central committees, a special committee being appointed to frame by-laws. A recommendation to appoint a permanent secretary with a salary of $200 per year was not adopted, the present secretary receiving $200 for this coming year. The newly elected officers are as follows: President, John McKinley, Ottawa; vice-president, F. Powers, Lunenburg, N.S.; secretary, H. A. Knox, Ottawa; treasurer, Ald. J. Lamarche, Montreal. The new provincial vice-presidents are: Nova Scotia, Cape Breton, and Prince Edward Island, G. H. Perrier, Halifax; New Brunswick, J. Walker, St. John; Quebec, J. Watson, Montreal; Ontario, W. Mansell, Toronto, Manitoba, Capt. Giroux, Montreal, and British Columbia, J. H. Wilson, Toronto. The following chairmen of committees were appointed: Sanitary, J. W. Hughes, Montreal; apprentices, R. Ross, Toronto; legislative, E. B. Butterworth, Ottawa; and essay, G. Martin, Yarmouth, N.S. The next convention will be held at Halifax, N.S. The delegates were tendered a banquet by the Toronto Plumbers' Supply and Toronto Master Plumbers' Associations, were shown the sights of the city on the trolley cars, and were photographed in front of the Lieut.-Governor's residence.

MELTING BRASS

C. Vickers, of Chicago, in a paper on this subject says: Whatever kind of furnace may be used, the melting and handling of copper alloys requires the most careful supervision on the part of the management, or the loss of metal will be so great that it plays havoc with the profits of the business. This loss is greater in summer than in winter, as the great heat to which the men are exposed saps their

vitality and makes it impossible for them to stand up to their work as well as in cold weather. More metal is therefore spilled in the furnaces and lost by oxidation. The ashes and skimmings should receive careful attention, and the recovered metal be promptly used up. The cost of melting may be greatly increased by the injudicious handling of crucibles.

Some brass foundries habitually use tongs with only one set of straps; tongs such as this are very liable to crush the pot, especially when used for pouring. They grip the pot a little below the bilge. When the lip of the pot is rested on the edge of the mold, and the tongs pulled over to lip it in pouring, if the tongs do not grip with great force the leverage will cause them to slip, and this is fatal to the successful running of light work. The pressure of the tongs being great enough to hold the pot firmly, it is soon squeezed out of shape and becomes oval. This continues until a crack is developed and the further usefulness of the pot is ended. Tongs with two sets of straps are the best, one set gripping below and the other slightly above the bilge. They are very liable to warp out of shape, however, and should be fitted from time to time to a new pot. Tongs with ace of spade shaped points, the ace gripping below the bilge and the straps around the same, ought not to be used in "pulling out," as the fuel will often prevent their going to place, and the points of the ace grip the pot where they are not intended to fit, and they sink into and pierce the softened pot. To obviate these troubles furnaces have been devised from which the crucible is never removed, the metal being poured out by tipping the furnace. This is all right on heavy work, but is useless on work where the metal must be used "jumping hot," as the transference to a pouring vessel will inevitably cool it. For exceedingly light work, experience has taught that small crucibles and tong pouring are the best.

It is a good idea to have two spouts to a crucible, one at right angles to the other. This second spout can be easily made with a file, before the pot is used. Then if both spouts are used alternately in pouring, the pot will retain its circular form and not be so liable to crush. Crucibles are often broken when melting ingot copper and heavy pieces of brass, by carelessness in packing the same when the pot is charged. Each ingot should rest on the bottom of the pot, and not be suspended by other ingots on the sides of the pot; otherwise when melting commences, these suspended ingots are liable to act as a wedge, and in sinking burst the softened crucible.

When brass is melted with ingot copper, it is often good practice to melt the brass first, placing the copper ingots on top of the pot, and when hot dropping them into the melted brass. This will cut them away, bringing the heat out quicker.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The election of officers of Toronto No. 1, C.A.S.E., for the ensuing year took place at its regular meeting on Wednesday evening, June 19, and resulted as follows: President, W. J. Webb; vice-president, R. H. Johnson; recording secretary, W. H. Johnson; financial secretary, N. V. Kuhlman; treasurer, S. Thompson; conductor, T. D. Bly; doorkeeper, J. Fox; trustees, J. Huggett, J. Bannan, N. V. Kuhlman; delegates to convention, W. J. Webb, J. Huggett, J. Bannan, W. L. Onthwaite and N. V. Kuhlman.

The Hamilton branch of the C.A.S.E. elected the following officers at its annual meeting, F. J. Sculthorp, president; J. A. Ferguson, vice-president; J. Ironside, recording secretary; G. W. Dawson, financial secretary; W. R. Cornish, treasurer; R. C. Pettigrew, conductor; N. Kitchen, doorkeeper; R. C. Pettigrew, Thomas Elliott, Peter Stott, trustees; Joseph Ironside and T. Chubb, representatives to the convention to be held in Brantford on August 20th; F. J. Sculthorp and J. A. Ferguson, alternates.

The annual meeting of Toronto No. 18, C.A.S.E., was held in Bathurst street hall on the 28th June, when the following officers were elected: President, Thomas Graham; vice-president, John J. Richardson, treasurer, P. Trowern; financial secretary, W. Inglis; recording secretary, John M. Dixon; conductor, James Coulter; doorkeeper, G. Gracey; auditors, Joseph Hughes and A. W. Vance; delegates to convention, J. M. Dixon and P. Trowern. The association has made very good progress during the year.

STEVENS ARMS AND TOOL CO.

H. M. Pope, of Hartford, Conn., has transferred to the Stevens Arms and Tool Co., Chicopee Falls, Mass., his special machinery for the manufacture and boring of the high grade rifle barrels which have made his name famous. Regarding the increase brought about by this and other developments the firm says: "Our force has increased from 44, six years ago, to 700

to-day. A year ago, shortly after acquiring the large Overman plant, which is one of the finest in the East, and gives us an additional 220,000 square feet of floor space, we tried to rent a part of it. To-day we are occupying nearly all of it ourselves and are contemplating an addition to our river plant." The accompanying cuts show the two plants.

NEW INCORPORATIONS.

Dominion charters have been granted to the following companies:

The Sarnia Bay Towing and Salvage Co.; capital, $15,000; office at Sarnia; E. Hall, W. H. Strong, E. H. Chaney, D. McKenzie, F. F. Pardee and D. Milne.

The following companies have applied for Dominion charters:

The Prosperage Shipping Co.; capital, $17,000; office at Yarmouth, N.S.; S. B. Robbins, J. A. Tilley, J. J. Clarke Robbins, B. G. Burrill and R. B. Somerville.

The Diamond Lighting Co.; capital, $500,000; office at Montreal; W. J. Poupore, T. Nadeau, J. A. Rafter, J. C. Malone, E. P. Ronayne, I. C. McRae, J. Bureau, F. S. Tourigny and M. J. Morrison.

The Louisa Mining Co.; capital, $200,000; office at Montreal; A. E. Cartier, L. A. Cartier, J. S. Trempe, A. Trempe and E. Rodier.

Ontario charters have been granted to the following companies:

The Hollywood Paint Co., of Hamilton; capital, $100,000, head office, Hamilton, Ont.; S. Jones, H. P. Coburn, N. S. Jones, C. T. Grantham and J. O. Cailaghan.

The Capital Sand and Brick Co.; capital, $50,000; head office, Ottawa, A. T. Shillington, E. E. LeBeree, J. Lavally, W. C. McCarthy, J. E. O'Meara.

The John Morrow Machine Screw Co.; capital, $75,000; office at Ingersoll; J. A. Coulter, O. E. Robinson, J. McBurney, W. H. Wortman, P. J. Myler, F. H. Deacon and H. Beattie.

The Belleville Hardware Co. capital, $40,000; office at Belleville; R. J. Graham, W. C. Springer, W. W. Chown, H. W. Ackerman, A. E. Lewis and W. Alford.

The Canadian Bent Chair Co.; capital, $25,000; office at Listowel; W. Hess, C. H. Smith, J. Sebinger, J. M. Schinlein and H. B. Morphy.

The Hespeler Furniture Co.; capital, $50,000; office at Hespeler; G. D. Forbes, W. H. Weaver, W. Renwick, T. Shaw, J.

R. Phin, R. J. Lockhart, A. J. Brewster, R. G. Scott and W. A. Kribs.

The Gold Mountain Co. of West Virginia, U.S.A., has been licensed in Ontario.

The Canadian Typograph Co., with a Dominion charter, has been licensed.

The Taylor Copper Mines Co.; capital, $2,000,000; office at Sault Ste. Marie; R. H. Taylor, H. P. Taylor, J. A. Greenough, J. C. Taylor, W. B. Hazenheath, T. H. Goodspeed and A. Elliott.

J. & J. Kerr Co.; capital, $40,000; office at Petrolea, Ont.; J. Kerr, A. McPherson, W. H. Hutchcroft, J. S. Cochran and W. Harris; lumber and oil boring business.

The Midland Packing, Canning and Cold Storage Co., capital, $40,000; office at Midland; R. J. Soden, C. L. Maltby, J. G. Marshall, L. A. Soden and A. K. Maltby

The Pakenham Pork Packing Co.; capital, $100,000; office at Stouffville, Ont.; J. Pakenham, J. Kendrick, W. C. Renfrew, H. J. Morden, J. Byer, and A. D. Bruce.

The Dowsley Spring and Axle Co.; capital, $100,000; office at Chatham, Ont.; T. B. Dowsley, F. J. Dowsley, A. M. Dowsley, M. Campbell, R. Gray and G. P. Scholfield.

The Peat Machinery Supply Co.; capital, $80,000; office at Toronto; A Dobson, B. Madill, G. R. Proctor, J. A. Morrison, C. B. Watts and H. Sutherland.

The United Electric Co., Toronto, has increased its capital from $150,000 to $300,000.

The Manxman Gold Mining Co.; capital, $1,500,000; office at Sault Ste. Marie; J. J. Nierling, J. B. Durkee, M. L. Parker, A. E. Nugent and A. Gibson.

New Brunswick charters have been granted to the Strathcona Coal Co.; capital, $120,000; office at Moncton, N.B.; I. W. Binney, G. E. Stopford, R. A. Borden, L. Binney and A. Stopford.

Quebec charters have been applied for by the following companies:

Terreault Steel & Malleable Iron Co.: capital, $200,000, office at St. Henri; A. A. Bernard, L. E. Bernard, F. Pauze and L. A. Bernard.

Shawinigan Lumber & Woodworking Co.: capital, $50,000, office at Shawinigan Falls; U. St. Onge, C. Lafond, C. Bousquet, R. K. Laflamme and F. Labelle.

British Columbia charters have been granted to

The Bluebell (Rossland) Mine, Ltd.; capital, $120,000; office at Rossland (extra provincial license).

The Montreal & Boston Copper Co.; office at Montreal; capital, $500,000 (extra provincial license).

Revelstoke Lumber Co.; capital, $20,000.

Albion Cannery Co.; capital, $50,000.

Dawson Hardware Co.; capital, $100,000.

The Mounts-Sicker & Brenton Mines; capital, $1,000,000

The Minnesota Mining & Development Co.; capital, $1,000,000.

The Columbia Hydraulic Mining Co.; capital, $1,000,000 (extra provincial license), office at Atlin.

The German Mining & Milling Co.; capital, $100,000; office at Nelson (extra provincial license).

Cherry Creek Copper King Mines; capital, $500,000.

Cedar Canyon Gold Mines; capital, $100,000.

London & Richelieu Mining & Smelting Co.; capital, $1,500,000.

Yukon Trading Co.; capital, $50,000.

Nicola Coal Co.; capital, $100,000.

Western Steamboat Co.; capital, $12,000.

Northern Development Co.; capital, $25,000.

Texada Gold Mines Co.; capital, $500,000; office at Van Anda, B.C. (extra provincial license).

Slocan Power Co.; capital, $50,000.

Spitzee Gold Mines; capital, $50,000.

New Fair View Co. (mining); capital, $1,000,000.

CANADIAN ELECTRICAL ASSOCIATION.

The 11th annual convention of the above association was held at the Russell House, Ottawa, on the 19th-21st June. A. A. Dion, president, in the chair.

There were present the following: From Ottawa, Thomas Ahearn, W. Ahearn, jr., A. Y. Soper, W. G. Bradley, Ormond Higman, John Murphy, E. J. O'Reilly, Geo. F. Burk, W. B. Morrow, Benj. H. Baldwin, C. Thomson, T. L. Richard, Geo. F. Macdonald, A. E. Caron, W. A. Duff, E. P. Featherstonhaugh, T. P. Neville, P. E. Marchand, C. H. Coursolles, Hector Dion, D. R. Street. From Toronto, Frederic Nicholls, H. G. Nicholls, Wm. McCaffrey, B. G. McBurney, James Kynoch, E. D. McCormack, J. W. Campbell and H. A. Moore of the Canadian General Electric Co.; Geo. J. Hicks (representing John Forman, of Montreal), B. F. Selby, A. B. Smith, J. J. Wright, Acton Burrows, Prof. Wm. S. Aldrich, of Smith & Aldrich, C. H. Mortimer, E. B. Biggar, W. L. McLeish and George Angus, the association's stenographer. From Montreal, K. B. Thornton, J. Atkinson Douglas, W. H. Browne, P. G. Gossler, J. W. Robertson, W. F. Dean and A. A. Stinson, of the Royal Electric Co. or Can. Gen. Electric Co.; Robt A. Ross, Prof. R. B. Owens, Fred. Thomson, J. P. Thomson, R. E. T. Pringle, John A. Burns (Munderloh & Co.), David Sleeth, W. B. Powell, G. R. Duncan (McGill University) F. W. Fairman, Geo. H. Olney (Eugene F. Phillips Electrical Works), Alex. Barrie, G. M. Wright, Alfred Collyer (Bullock Electric Mnfg. Co.), F. H. Leonard (Thos. Pringle & Sons), E. E. Cary, A. G. Grier (McGill University), C. Doutre (representing John Forman), Thos. Rodger and A. Milton Smith. From Lindsay, Thos. Sadler and B. F. Reesor. From St. Catharines, R. B. Hamilton and G. A. Powell, of Packard Electric Co. From Sherbrooke, Andrew Sangster and R. N. Robins. From Hamilton, W. F. McLaren and F. W. Martin. From other places, J. A. Robertson, Vankleek Hill; H. O. Fisk, Peterboro; L. Denis, Quebec; John Yule, Guelph; J. W. Purcell, Walkerville; R. J. Smith, Perth; V. B. Coleman, Port Hope; L. H. Reesor, St. Mary's; E. J. Kyle, Merrickville; J. K. Skidmore, Cobourg; D. A. Starr, Cornwall; Raoul Girouard, Smith's Falls; G. U. G. Holman, Quebec; G. L. Kitchen, Newmarket; J. M. Brown, Carleton Place; W. R. Taylor, Aylmer; A. H. Carswell, Pakenham; E. L. Reynolds, Philadelphia; W. A. Layman, St. Louis, Mo.; Philip H. Hover and H. W. Blivens, New York; H. B. Kirkland, Chelsea, Mass.

President Dion opened the proceedings by a few words of welcome to the members, and trusted the convention would be both pleasant and profitable to them.

Mayor Morris gave the convention an informal but hearty welcome, and was followed by Aldermen Deering and Desjardins, members of the local committee, on behalf of the city council. The Committee on Legislation, of which R. O. McCulloch was chairman, presented a report, which was read by J. J. Wright, of Toronto. The report stated that while no direct attack on the Conmee Act had been made during the past year, a bill had been introduced into the legislature on behalf of the city of Toronto, designed to relieve it of the provisions of the act. This bill arose from the disputes of the city council with the Consumers' Gas Co. The bill, which passed, had the effect of excepting Toronto from the operation of the act, so far as the Consumers' Gas Co. act was concerned, and enabled the city to establish a municipal gas plant. An agitation arose during the year to repeal the assessment act, and this led to the appointment of a commission on the subject of assessments. The electric light companies were represented at the session to watch the progress of this agitation. No electric light company, the committee observed, has ever taken advantage of the scrap iron decision. The commission made an interim report, recommending that a law be enacted providing that all property of such companies having franchises should be taxed, first on the valuation of the land, and then on the valuation of buildings and works, on the basis of the cost of their reproduction. The government then introduced a bill to repeal the act on which the scrap iron decision was based, and also a bill to relieve the companies affected. It was found, however, that these were large questions, and both bills were left over until another session. The assessment question is sure to be dealt with next session, and as the committee consider it

Canadian Electrical Association—Convention of 1901—Photographed in front of the Parliament Buildings. Photo by A. G. Pittaway.

wrong to be taxed on the cost of reproduction of the plant, something will have to be done to meet the movement against the company. The collections made through Mr. Mortimer last year for the expenses of the committee's work only realized $253, which, after deducting an adverse balance of last year, left only $220.14, while the expenses are $287.26.

O. Higman, on behalf of the committee on rating of arc lamps, reported that the act had been amended at the last session of parliament, giving power to fix a standard rating, and the committee will be able during the current year to arrive at something definite.

The president appointed Messrs. Brown, Wright and Reesor as a committee to strike the standing committee.

The report of the secretary-treasurer, C. H. Mortimer, showed a steady growth in membership. The valuable work performed by the legislation committee had widened the influence of the association, yet many of the companies who benefit largely by this work stand aloof. "If the privilege of membership were offered to electrical students in our scientific schools at the nominal fee of one dollar per year, as is done by the Mining Institute, it might be the means of inducing yearly additions to the membership of bright young men who in time would pay the regular fees and do valuable service towards advancing the objects of the association. In this connection it has occurred to me that the association might also think it advisable to offer a yearly prize to the Third Year students in the electrical department of these schools, thereby manifesting its interest in scientific education, and at the same time keeping the association and its work constantly before the attention of the young men who will take a prominent part in the development and management of electrical enterprises in the future."

The president and secretary were instructed to memorialize the Dominion Government looking to the establishment of a testing department which would be at the service of electric lighting companies on payment of reasonable inspection fees

The number of members at present on the roll is as follows: Active, 235; Associate, 32; total, 267, a gain of 23 since last report.

Following is a statement of the receipts and disbursements:

FINANCIAL REPORT FROM JUNE 1ST, 1900, TO MAY 31ST, 1901.

RECEIPTS.

Cash in bank, June 1st, 1900	$330 83
Cash on hand	15 20
121 Active Members' fees at $3	363 00
16 Associate Members' fees at $2	32 00
C. H. Mortimer, to replace convention buttons lost at Hamilton convention	6 25
Legislation Committee, C. E. A., envelopes used	1 00
Loan of cuts	6 07
	$750 35

DISBURSEMENTS.

Convention Expenses—	
Convention buttons	$ 12 50
Grant to local committee	95 00
George Angus, stenographer	35 00
C. Clement, assistant to secretary	3 00
"Electrical News" printing account	94 90
Cuts to illustrate convention papers	23 16
Ribbon for badges (1900)	1 11
Express charges	1 60
	$266 27
Unpaid accounts, 1899-1900	17 85
Grant to secretary	125 00
Secretary's expenses to Montreal	26 90
Postage	26 00
Exchange on cheques	3 10
Telegrams	2 23
Stationery	8 60
Express charges	75
Ribbon for badges (1901)	2 81
Membership cards (1901)	4 00
Balance on hand	282 74
	$750 35

K. B. Thornton then read his paper on aerial systems of transmission and distribution, printed elsewhere.

In discussing the paper, B. F. Reesor said the transmission line at Lindsay was almost the same as that described, except that they did not use barbed wire on the cross arm, but grounded a wire at every other pole.

P. G. Gossler, of the Royal Electric Co., said the experience of his company on the Chambly transmission line showed the advantages of barbed wire as a protection against storms. A recent thunderstorm arose in Montreal and traveled to Chambly, right over the line; but while the storm disorganized the city and local lines, there was no discharge at all on the Chambly line. In three years there had never been a noticeable discharge on this line

F. W. Martin said they had run at Hamilton a part of this summer without any kind of lightning arresters. They were in doubt as to the advantages of the air-gap arrester

J. W. Campbell thought this paper ought to be in the hands of every electrical engineer. He understood barbed wires were used on the Niagara Falls-Buffalo line

O. Higman had known of poles being destroyed by the dozen where there was no protection. In England where lines had a ground wire on every second pole there was no trouble.

Mr. Moore observed that one difficulty about barbed wire was corrosion and poor wire.

The president suggested steel wire as an improvement over common barbed wire.

H. O. Fisk thought the grounding of wire made it a danger to men who had to go up these poles.

O. Higman suggested that wire could be manufactured with spurs from the wire itself to replace barbed wire.

A. B. Smith referred to the peculiar behaviour of barbed wire in sleet storms. Some years ago in Western Ontario a heavy storm of sleet occurred, and he noticed that while telephone and telegraph wires were broken down in all directions from the weight of ice there was not a particle of ice on the barbed wires, and none broken. He attributed it to the slight twisting movement of the two strands of wire.

Other speakers had noticed the phenomenon, but had never been able to account for it.

B. F. Reesor said his company had no trouble with their barbed wires. The only drawback with the barbed wire was that when it did break it went into forty kinks, and made matters disagreeable if not dangerous.

K. B. Thornton said that in Montreal the transmission line was above the telephone lines. There was no trouble in the centre of the city, but the difficulty was at each end where the greatest strain was during storms. For that reason arresters should be at the ends of the line. They had recently put in some ground wires, which were protected by a moulding.

At the afternoon session Mr. Higman raised the question of the expense of the annual banquet. The chief income of the association was wasted in the dinner, and he thought the money could be put to better use than in "guzzling." He gave notice of motion that the funds should no longer be used for this purpose.

The president appointed J. W. Purcell, and And. Sangster as auditors.

After the reading of Mr. Higman's paper, given elsewhere, the president referred to the benefits of the government standard instruments at Ottawa.

F. H. Leonard recommended that a resolution be passed asking the government to establish a standardizing bureau, so as to allow the various companies to compare their instruments without having to send them out of the country.

The president said the American Institute of Electrical Engineers was working in the same direction, and the United States government was increasing the scope of its testing work. He asked what facilities existed at such institutions as McGill University.

Mr. Duncan replied that they had at McGill a very complete set of calibrating instruments, showing what should be the reading of an instrument, but he did not think they repaired such instruments when wrong.

Mr. Higman said the United States congress had appropriated $200,000 to establish a bureau for standardizing electrical instruments, and he presumed they intended to repair as well as compare.

A discussion then took place on the point whether repairs should be done by such a bureau or by the makers of the instruments. Finally a committee consisting of F. H. Leonard, P. G. Gossler, J. W. Campbell and Prof. Owens, was appointed to formulate the recommendations of the association on the subject.

After the session was over the members were treated to a carriage drive about the city, tendered by the citizens, and in the evening to a trip to the Ottawa Electric Co.'s charming new park at Britannia-on-the-Bay. The company had provided special cars and their attention on this and other occasions were much appreciated.

On Thursday the president reported that H. L. Doherty, of New York, was unable, owing to illness, to be present, or prepare his promised paper on rates for electric lighting.

J. R. Robertson, of Montreal, then read his paper on "The Influence of the Load Factor on the Design and Operation of a Lighting and Power System." In the course of his paper the author recommended that the rate be based upon the maximum load demanded and not upon the average. From the supply company's point of view variable loads are not desirable as they are destructive of good regulation. Any rate therefore based upon the maximum puts a penalty upon poor apparatus and a premium upon good to such an extent that customers demand from manufacturers that the machinery must keep within fixed limits of power consumption, thus benefiting the customer through his reduced bill and the supply company through the improved regulation. In Montreal this policy has materially improved the conditions of load of a great many customers, more particularly those to whom power is supplied for elevator service. Passenger elevators that used to require 30-h.p. to start now manage to start on 15 to 20-h.p., and there is no noticeable diminution in their speed or service. Freight elevators that used to demand 7-h.p. to start under load are now started on 5-h.p., and factories that used to find it inconvenient to operate all their heavy machinery at once, now find it economical to distribute the use of it throughout the day, so reducing their maximum demand and making their load much more regular.

In re-arranging a plant for a combined light and power service from the same generators and circuits, one of the first questions is the frequency. In former days when the lighting service was everything, a frequency of about 16,000 alternations per minute was about the most common. For exclusively power work the frequency most favored was about 3,000 or less. At this latter figure the flickering of incandescent lamps is decidedly disagreeable and the operation of alternating arc lamps is almost impossible. At the high frequency the operation of motors is difficult, that is in large numbers and sizes as the inductive effects are great and the power factor consequently low. The result of this is a compromise. A frequency of about 7,200 or 8,000 is sufficiently high to permit of the satisfactory operation of incandescent and arc lamps without noticeable flickering, and sufficiently low to permit of the operation of induction motors with a power factor reasonably high, and a speed reasonably low. This frequency too is about the upper limit at which rotary converters can be operated satisfactorily. There remains the question as to whether the generators with the transmission and distributing system shall be two-phase, three-phase, or some combination of the two. For the system under consideration the generating plant should be two-phase. The unbalancing effect of lighting on single phases has less effect on the regulation than it has on a three-phase generator under the same conditions. Where power has to be transmitted over a considerable distance, it is better for economy in wire, to transform to three-phase in stepping up to the high line voltage, and at the receiving end in stepping down transform back to two-phase. Where the lighting forms any proportion of the load distribution two-phase is preferable to three-phase from the regulation point of view. Three wire two-phase systems, though somewhat more economical of copper than four wire systems, are not generally so satisfactory, on account of the higher voltage, and trouble from wires during storms and burning down. With the distribution two-phase there is no trouble in connecting three-phase motors when this is desired, as the regular motor transformers can be used, the only alteration necessary being the bringing out of a lead from the middle point of one coil.

As to the type of motor the only one to be considered for small power is the induction motor. Its simplicity, the ease with which it can be started and stopped and its comparative freedom from the annoying troubles that beset its rivals make it an ideal machine to put into the hands of a customer. There is practically nothing to do except to see that the bearings are properly oiled. Dust and dirt have very little effect providing the oil in the bearings is changed frequently, the motor can be mounted on the wall or ceiling almost as easily as on the floor, and no extra wiring is necessary if the starting devices have to be placed some distance from the motor. Heavy loads have not the same power to injure it as with other motors, as if overloaded too much it merely stops and load must be removed before it will start again. Such a thing as a burned out induction motor is almost unknown. It is true that with motors of the wound type short circuits and grounds sometimes occur, but these can generally be traced to some defect in manufacture.

The synchronous motor on the other hand can readily be operated at a power factor of unity. If the motor load is considerable this makes a very material difference to the operating station as the effect of a large amount of load even with a power factor as high as 94 is to increase the field current of

the generators very decidedly. If they are of modern construction and have good regulation on low power factor loads they may be able to deliver full load current without exceeding the limits of field current, but even in this case the output of the station is lowered, as the power is generally sold on a basis of true energy and not of volt-amperes. To offset this advantage these motors should be operated at a comparatively high load.

An induction motor acts as a sort of regulator on the lines, by absorbing more power from the phase with the high voltage thus tending to lower it to equality with the others. Changes of load on induction motors have also less effect on the regulation of the system than with synchronous motor, since the lowering of the load lowers the power factor, thus reacting on the generator field and preventing somewhat the rise of voltage which accompanies a reduction of load. A great drawback from a lighting point of view to induction motors is that to start they require anywhere from one hundred to two hundred per cent. of full load current.

The synchronous motor while possessing many advantages has also some drawbacks. The attendant can by varying the exciting current alter the voltage of the lines to such an extent as to seriously interfere with the regulation. Again any violent disturbance on the line is likely to pull a heavily loaded synchronous motor out of step, and with motors of low self induction this makes a vicious short circuit. If there is any large amount of load driven by motors of this type the effect of a heavy short circuit would be to pull them all out of step, thus holding down the voltage. The removal of the short circuit together with this large load would permit the voltage of the generators to rise considerably with disastrous effects on lamps burning on the circuits. In the case of large mills to which continuity of service means much, the starting of a large number of synchronous motors occupies considerable time and the loss by delay is worthy of consideration. The principal advantage of the synchronous motor lies in the fact that its power factor is under the control of the operator, who, by raising or lowering the exciting current can make the current leading or lagging at will, and by properly adjusting it can operate the motor with a power factor of unity. The fact that by over exciting synchronous motors lagging currents due to induction motors or arc lamps can be compensated for is of the utmost importance. If these motors are under the control of the station staff, they become valuable means of increasing the output of the station. In plants where machinery is not in use during the day, it is advisable to have the motors of the synchronous type, as in this case they can be used all day as condensers supplying to the line the leading current necessary to balance the lagging component due to the inductive load. Properly designed motors operating in this way cause no trouble from pumping, even when over-excited, till the armature current is at full load value. These motors, after being used as condensers all day, are operated at night to drive their regular load. In placing synchronous motors on customers premises beyond the control of the station, it is advisable to install some sort of power factor indicator. When it is considered that a reduction in the power factor from unity to 99 per cent. involves an increase of the wattless current to about 14 per cent. of the motor current, it can be understood how important it is that the power factor be kept up. As the exciting current varies for different loads and voltages it is almost impossible where the load is variable to keep the power factor unity. There have recently been several types of power factor indicator devised, but the simplest for two phase systems is an induction wattmeter with its series coil connected in one-phase and its shunt coil across the other phase, or across a transformer if it is necessary to reduce the voltage. When connected in this way the meter will run in one direction if the current is lagging and in the other direction if the current is leading, remaining stationary if the power factor is unity. If the meter is properly marked, it is only necessary for the operator to regulate his exciting current as indicated by the disc of the meter. In this way the station can protect itself against the possibility of the regulation being taken out of the hands of the switchboard attendant.

Standing committees for the ensuing year were appointed as follows:

Committee on Statistics—A. A. Wright, of Renfrew (chairman), K. B. Thornton and J. F. H. Wyse.

Conference with Underwriters—P. G. Gossler (chairman), Edw. Slade, A. A. Dion, Geo. W. Sadler, J. J. Wright and And. Sangster.

Arc Lamp Rating—O. Higman (chairman), P. G. Gossler, Fred. Thomson, John Yule, Prof. Owens, J. R. Robertson and W. B. Lambe.

Legislation—John Yule (chairman), B. F. Reesor, A. A. Wright, J. J. Wright, C. B. Hunt, W. H. Browne, A. A. Dion, W. H. Breithaupt and R. O. McCulloch, with power to add to the number.

Standard Accounting—D. R. Street (chairman), H. H. Henshaw and A. A. Wright.

The paper by L. Denis, of Quebec, printed in another part of this issue, was then read. In reply to Mr. Fisk, Mr. Denis said the Junction box referred to in the paper was an ordinary street car motor fuse box. They had to be inspected once a week to replace blown fuses. The fuse was a common lead fuse, and the junction box was one-third the capacity of each transformer.

On motion of B. F. Reesor, seconded by John Yule, it was decided to send a resolution of condolence to A. A. Wright on the death of his daughter.

Discussion then took place on the subject of creating a new class of membership for students. It was the general opinion that the proposal was a good one, and on motion of Mr. Purcell a resolution approving of the principle was adopted. Messrs. Nicholls, Wright, Purcell, Hamilton and Leonard were appointed a special committee to draft an amendment to be approved at an extra session of the executive on Saturday.

An important discussion, led by Frederic Nicholls, then took place, on the general policy of the association's administration. Mr. Nicholls took the ground that the executive offices of the association should be held only by men who are professional electricians, either engaged in scientific study, or in operating central stations, or other electrical work, as distinguished from those selling machinery or supplies. He was present at the first meeting to organize this association, and he declined the offer of the vice-presidency for the simple reason that he was then concerned in the commercial end of the business. As he declined then for the reason stated, to take advantage of the offer of election, he now held that the responsible offices should be held by no others than men whose business was electricity, and that there should be a clear line drawn between Active members and Associate members, in which latter class the supply men would come. Mr. Nicholls' position was generally endorsed, and when, at a subsequent stage, the name of E. E. Cary was proposed for the presidency, that gentleman said he fully agreed with the principle laid down by Mr. Nicholls, and begged to withdraw his name.

Prof. Owens' paper, printed elsewhere, was then read. In reply to questions the author said this impedence coil and condenser were not affected by wave forms as in the shunt coil. The static condenser was now being developed, and its practical efficiency would probably be shown before long, when it would allow of several thousand volts.

Prof. Aldrich said it had been very clearly shown in the experiments recounted by Prof. Owens, that the difficulties ordinarily met with in alternating current series arc lighting might be obviated, if not altogether overcome. The low power factor of such a system might be brought well nigh up to unity, by neutralizing the several inductive reactances of the system by suitable condensers or by their equivalents. It was not necessary to depend upon condensers, as used by Prof. Owens, to accomplish this object, since synchronous machines, whether generators or motors, if similarly connected across the line (in parallel) would effect the same purpose when operated with proper field excitation. That is, these machines should then be excited somewhat above their normal value, in order to give the necessary leading components of wattless current to neutralize the existing lagging wattless components of the series arc lighting system. It had been shown by many experiments that this is not only feasible but very desirable. It results in a satisfactory performance of the whole arc lighting system, so connected and operated, at nearly unity power factor. The arc lamps are much steadier, more reliable, have better regulation, give more uniform light, and are greatly improved

in efficiency, by such an arrangement. In fact, the ideal conditions are then realized for the performance of any such system of alternating-current distribution, whether for light or for power, as touched upon in the paper of Mr. Robertson. In using synchronous motors to effect such neutralization of wattless currents they are not open to the same objections as with induction motors, as pointed out by Mr. Robertson. For the load is practically constant with the arc lighting service, while it may be quite variable in the case of induction motor service, in which similar neutralization may be attempted. For any given number of arc lights the best operating conditions may easily be determined, by a little trial, and the field excitation of the synchronous machine kept constantly at that point during the all-night run of the series arc lamps, on its circuit. A lamp or so going out will not materially affect the conditions and the regulation. Series arc lamps are proverbially difficult to manage, owing very largely to the varieties of wave forms from the generators used. A given arc lamp, adjusted for satisfactory performance at the factory will often require a laborious adjustment to be made again when placed on the circuit of another generator having a totally different wave form. These two difficulties, therefore, of very low power factor of the system and wave-form variations, may be met most satisfactorily by just the conditions brought about by using condensers or synchronous machines; namely, to effect as nearly as possible complete neutralization of the several wattless components and operate the system at about unity power factor.

Under the head of "Topical Discussions" Andrew Sangster and F. W. Martin submitted themes. Mr. Sangster's topic was "Enclosed Arc Lamps," in treating which he said: "We have had the series alternating enclosed arc lamps in use for almost two years. We did not have much of the summer weather ahead of us when we installed these lamps, and found the first winter harder on lamps, and made more difficulty in the trimming than in the past winter, owing to defects in the lamps, which the makers helped us to remedy. These defects were found after the first storm, water getting into the works of the lamps. We also found the holder for the outside globe frozen to the globe and the screw, which made it almost impossible to remove. The current had to be put on for an hour sometimes in order to heat the lamps enough to get the globes removed. Several lamps were destroyed by frost and water and many globes broken. These defects being remedied there were fewer breakages last winter. During the shortest days in winter we trim once in five days, and in the longest days of the summer we trim once in ten days, taking one carbon for each lamp when the trimming is done. The carbons for these lamps are one solid and one cored, and nine inches in length. At the first trimming there is a nine inch carbon put in the upper holder, and about six inches in the lower, and at the next trimming the carbon from the upper holder is put in the lower one and the new carbon put in the upper, the upper solid and the lower cored. These are reversed at the next trimming. We had a case with 25 inner globes which the trimmer took out with him and brought in the dirty ones. This was when we started on these new lamps, but after carefully watching the lights I found that the trimmer with care could clean the globes and make them show the light equally as good as new ones. These globes are slightly of the opal kind, and we clean them out with a swab of cloth. On our system we have two circuits of 46 lamps each, the trimmer taking one circuit in one day. Our circuits are much extended so that a horse and buggy is necessary for going the rounds. I may say that there are many times in the winter when it is impossible to clean the globes, in which cases they are then changed and taken to the station. Some of our lamps are hung on guys in the middle of the streets, and others are on arms about 12 feet out from the pole. We raise and lower our lamps by means of a small windlass and wire cable, which I have used for about ten years. These windlasses are placed about seven feet from the ground, and one handle does for all of them. I had a stool made with glass supports and covered with rubber and rough glass to protect the man from grounds, and have not found any trouble in fixing a lamp when needed. With regard to inspection of lamps. The trimmer goes around when the current is put on the lamps to see if they all start up. There are times in the winter when some of them will stick, but a shake of the cable will generally start them. The number out will average about 20 a month in winter, and in summer it is a rare case to have a lamp reported out. When a lamp is reported out two nights it is taken in and repaired. We had ten extra when we put in the system. We have still the 10 spare ones, as the repairs have been light since the first winter. We have no patrol man during the night. We make enquiries at the Police Station if any are reported out, and it is only during the winter when an occasional one may be out a short time. The council and citizens are much pleased with the new lamps, and owing to the opal globes the light is not hard on the eyes when driving near the lamps, and yet the light seems to be better and throws further."

Mr. Martin's topic was the "Series Alternating Arc Light System for Street Lighting." He said: "We have had nearly eighteen months' experience, and while we have had our troubles, things are now settled down, and are more satisfactory both to the company and to the citizens. When we first started we used the opal inner chambers. They, no doubt, diffused the light more, but they certainly cut it down, and we found them harder to keep clean. We are now using a clear inner chamber on all our street lamps. They give a sharper light and more like the old direct current lamps without the shadows. As regards trimming, we have two city trimmers and a patrolman. The trimmers each have a rig which is fitted up with boxes to carry the chambers, made something after the style of an egg case. There are also pockets for the carbons in these boxes. In the front of the rig he carries a spare lamp and an extra globe or so. Each man has about 210 lamps to look after, and does the changing and small repairs. We bring in all the inner chambers when trimming, and they are replaced with clean ones each time. The ones taken off are returned to the station, and are washed in a solution of washing soda and warm water, and after being rinsed in clean water they are placed on pegs to dry ready for the next day. We consider this better than leaving them to the trimmer to clean on the streets, as the chances are he will only half wipe them, and at best he leaves them streaked. This accumulating deposit cuts down the light considerably. We use a pear shaped chamber, which has no opening in the bottom, and we find this better than the open type, as it does not allow a current of air to pass through, which would reduce the life of the lamp. Of course ordinary care must be used to keep these tight up to the gas check. The carbons are all passed through a gauge before going out, and only those within the limit .505 to .520 are used, as any over size might cause the lamp to go out by sticking in the gas check, and if under size will reduce the life of the lamp by letting the gas escape too freely. We find it better to bring in the upper carbons at each trimming, and these are cut the proper length ready for the next day to be used as lower carbons with the new uppers. The idea is to be sure that the carbons are the proper length, for if too long it burns into the gas check, and if too short it shortens the life of the lamp, or burns into the lower carbon holder. The patrolman has a rig, and drives around the city twice each night, and sees the lamps at least three or four times each. He makes out a report, and also marks any lamps to be changed. Each trimmer sees the patrolman's report in the morning and makes any necessary changes. Our commercial trimmer does work very much the same, only he has no rig, and has to inspect the lights during the fore part of the evening, taking in city lights on his route."

Mr. Leonard raised the question of charging for light and power, and suggested experiments in getting manufacturers to so arrange their hours that when night came on and incandescent lights were turned on, power could be turned off. In Montreal one large consumer, employing many hands, arranged to start work at the factory at 6 a.m., and to shut down at 4 in the winter, with a provision for starting again after 7 p.m. when overtime had to be run. The work people did not like the change at first, but after a short experience they preferred the early hours for the sake of getting off early in the afternoon. Where such an arrangement could be made general in a combined lighting and power service, it would so equalize the consumption of current that it would pay the operating company to share with customers the saving effected.

Messrs. Nicholls, Sangster and Reesor thought with Mr. Leonard that if the factory hours could be adapted to the demand for light in winter, both the consumers and the electric company would be gainers.

A vote of thanks was passed to Thos. C. Keefer, C.E., for presenting members with a map of the water powers of Canada, prepared by him in connection with a paper read before the Royal Society of Canada.

An exhibition of the work of the Ottawa fire brigade, followed by a street car trip to Rockliffe Park, varied the proceedings in the afternoon. In the evening the annual dinner was held at the Russell, and proved an enjoyable event. President Dion presided ably. After the toast of the King, Mayor Morris and A. Y. Soper replied to "Our Guests." "Kindred Associations" was proposed by E. E. Cary, vice-president, and responded to by Frederic Nicholls on behalf of the National Electric Light Association; Thos. Ahearn on behalf of the American Institute of Electrical Engineers, and Col. Anderson for the Canadian Society of Civil Engineers. The company broke up about 12.30.

On Friday, O. Higman moved, seconded by J. J. Wright, that hereafter the funds of this association be not used for the purpose of entertainment. This was carried, it being the sense of the meeting that more simple luncheons or dinners could be arranged for by tickets, for which members could subscribe or not as they felt disposed

The election of officers was then proceeded with, and resulted as follows:

President—F. G. Gossler, Montreal.

First Vice-President—B. F. Reesor, Lindsay.

Second Vice-President—Edward Slade, Quebec.

Sec.-Treas.—C. H. Mortimer, Toronto.

Executive Committee—J. J. Wright, O. Higman, A. B. Smith, W. H. Browne, John Yule, A. A. Dion, John Murphy, And. Sangster, Geo. U. G. Holman and K. B. Thornton. The five last named are the new members of the committee.

The city of Quebec was selected as the place for the next annual meeting.

Mr. Leonard having been moved to the chair a vote of thanks was passed to President Dion for the faithful way in which he had discharged his duties. Votes of thanks were also passed to the various corporations and individuals who had helped the convention or entertained the members.

The convention closed with a trip to the Chaudiere and the Deschenes Rapids, by courtesy of the Hull Electric Co.

On the following day a special meeting was held at which amendments to Articles III. and V. of the Constitution were passed as follows:

ARTICLE III.

Membership—The association shall consist of Honorary, Active, Associate and Junior members. The term "Active member" shall include all those actively engaged in operating electrical enterprises, electrical engineers and those engaged in matters of electrical education. The term "Associate" includes all others applying whom the executive committee consider eligible to become members of the association. They shall be entitled to attend all meetings of the association, except those of the executive, and take part in all discussions, but shall not be entitled to vote for the election of officers or be eligible for office. "Junior members" shall be confined to those pursuing the study of electrical engineering, and no person shall be eligible for this membership for a term exceeding two years, after which they may apply for Active or Associate membership. Honorary members shall only be elected by a two thirds vote of the Active members present.

ARTICLE V.

The annual fee shall be, for Active and Associate members, $3, the executive committee being authorized to increase this fee to a sum not exceeding $5, at any time they may deem it expedient in the interests of the association. The fee for Junior membership shall be $1 per annum, payable in advance.

The International Association of Machinists held their annual meeting in Toronto last month, and elected the following officers. President, Jas. O'Connell, Oil City, Penn., re-elected; vice-presidents, 1st, vice-pres., J. P. Conlon, Sioux City, Iowa; 2nd, A. W. Holmes, Toronto; 3rd, Geo. Mulberry, Chicago; 4th, Thomas L. Wilson, Cheyenne, Wyoming, and the 5th yet to be elected; also an executive board of five and a sec.-treas. D. D. Wilson, formerly vice-president, is to be the new editor of the journal.

NOTES ON THE CONSTRUCTION AND PROTECTION OF AERIAL TRANSMISSION AND DISTRIBUTION SYSTEM.*

BY K. B. THORNTON, MONTREAL.

In this country the majority of transmission and distribution systems are of overhead construction, and are likely to remain so for many a long day. As these systems are exposed to all kinds of weather it is a matter of great importance to those who are operating the same that they be constructed and protected in the best possible manner. Aerial lines are constructed by placing wooden or iron poles in the ground generally at distances varying from 105 to 120 feet apart in cities, and from 90 to 100 feet apart for high voltage transmission lines in the country. For wooden poles, cedar wood, owing to its lasting qualities is generally used up to lengths of 50 or 55 feet; beyond this length they are hard to get of suitable proportions, the tops being often too small and the butts too large and the price prohibitive. Apart from this cedar is also too brittle a wood to use for high lines. Spruce and pine poles are therefore used where lengths over 55 feet are required, chestnut and other desirable woods not being obtainable in this country. As it is daily becoming harder to get long poles it is often necessary to resort to splicing poles to get the proper lengths. Good cedar poles will last for twenty years and more without showing any signs of rotting but red pine poles will generally rot at the butt in cities in less than ten years, and spruce poles often show signs of rotting in four or five years, depending very much, however, on the nature of the ground in which the pole is located.

With a view to increasing the life of spruce and pine poles it is customary when placing them to coat the butts with a heavy coating of tar. The length of poles is governed by the conditions of locations. They are usually from 40 to 65 feet, and to clear high buildings, from 75 to 80 feet. Experience has shown that it is advisable to keep the lengths of the poles as short as possible, as they are less exposed to the weather, and it is generally a hard matter in cities to guy them. Throughout residential and suburban districts and for transmission lines through the country the usual length for poles is 40 feet. The following are some of the essential features of a pole contract: Poles to be of good, sound, well shaped line cedar wood, not less than seven inches in diameter at the small end. Poles to be cut square at both ends and the bark stripped off clear from the top to within six feet from the butt, and all knots to be neatly trimmed off; no pole will be accepted with two curves in it. Poles will be inspected and branded at point of shipment, the inspector having the power to reject any pole that he may consider to be unsatisfactory.

Shaving Poles.—Poles when unloaded at the pole yard are inspected and shaved, the cost of shaving averaging about ¾ cent per foot.

Setting Poles.—In regard to the setting of poles no regular rule can be given for the depth which they should be set in the ground; usually it is from 5 to 7 feet, depending on the height, location and the condition of the ground in which they are located. The following are the usual depths of setting in good ground: A pole of 35 to 45 ft. high, 5 ft. deep; one of 50 to 55 ft., 6 ft. deep, and one of 60 to 80 ft., 7 ft. deep.

In marshy or "made" ground it is often necessary to concrete the butts of poles, using a mixture composed of one part of cement, three parts of sand and five parts of broken stone. Up to a height of 45 feet poles are set with pike poles and a dead man, and over that height with a derrick. The number of men for each given height of pole will be as follows: 30 ft. high, 6 men with pike poles; 40 ft., 7 men with pike poles; 60 ft., 10 men with derrick; 70 ft., 15 men with derrick; 80 ft., 15 men with derrick.

Should the poles be wet one or two additional men may be required on account of the extra weight. The gains are cut while the pole is on the ground and also when used in cities the holes drilled for spikes. When a pole is once set, the earth is well tamped round the butt; this is especially necessary in the early spring when the frost is not quite out of the ground, and if not properly attended to, the poles will get out of line in a very short time.

*A paper read before the Canadian Electrical Association.

Spikes are of square wrought iron, 9 in. by 9-16-in.—two men being able to drive about 500 per day of ten hours, once the holes are bored.

Cross arms are usually of red or yellow pine and vary in length for ordinary city service from 2 ft. 6 in. for a two pin arm, about 8 ft. for a six pin arm, and have a sectional area of 3¼-in. by 4¼-in. for all ordinary work; for transmission lines the dimensions will vary from the above depending on the nature of the transmission service. Cross arms are rounded or chamfered on the top side to prevent water gathering and lag screwed to the poles with 7-in. by ½-in. lag screws. Some prefer to fasten the cross arm with bolts passing through the poles, but our experience has been that it is easier to replace cross arms that have been lag screwed than those which have been bolted, as the bolts generally rust, making it necessary to use a drift to drive them out.

Braces.—All four and six pin arms should be braced with flat iron braces not less than 1¼-in. by ¼ by 27-in., bolted to the cross arm by 4 in. by ⅜ in. machine bolts at one end and either lag screwed to the pole with a 4-in. by ⅜-in. lag screw or bolted to the next cross arm underneath. On important transmission lines with long and heavy cross arms, where very strong work is required, braces of angle-iron in one piece are sometimes used. A brace composed of one piece has some distinct advantages, for instance, some time ago one of the wires on a high voltage transmission line slipped off the insulator on to the cross arm, and the current to ground through the pole burned the cross arm clean off the pole, leaving the two outside ends of the arm supported by the brace, permitting the service to remain uninterrupted until such time as the line could be conveniently shut down. Pins are fitted in holes drilled in the cross arms about 15 in. apart and 22 in. between the centre two pins, and secured by a wire nail driven through the cross arm. After considerable experience with oak pins they have been abandoned in favor of 1½-in. locust wood pins, it being found that oak pins after five or six years were inclined to rot and break off at the shoulder when subjected to any great strain. Where great strength is required at corner poles or for dead ending, it is advisable to use solid iron pins. On long straight runs it is advisable to set the cross arms in such a way that they alternately face each other on adjacent poles and are back to back on the next two poles; in this way, should a stretch be cut down or a pole break, there is less danger of the cross arms being wrenched off than if they were all set in the one direction. At all long stretches, corners, and for dead ending, cross arms should be doubled, with a spacing block at either end of same and fastened at the ends by bolts run through the spacing blocks.

Insulators.—For regular line voltages of 2,000 to 3,000 volts, the ordinary deep grooved, double petticoat glass insulators are used; for higher voltages it is necessary to use specially prepared triple petticoat insulators of porcelain or a combination of porcelain and glass, so proportioned as to give the greatest distance between the point of support of the wire and contact with the pin, and at the same time permitting of a minimum amount of surface leakage. These insulators are ordinarily subjected to a break down test before being placed, in order to locate defects.

Wire.—For all ordinary line work soft drawn copper wire is preferable to hard drawn, the disadvantages, in using it due to increase of sag being more than offset by the difficulties in handling hard drawn wire and the possibilities of damaging same when it is being erected. As yet aluminum has not come into general use for overhead construction owing to the difficulty of making proper joints and the greater size of the conductor necessary to get the equivalent conductivity of copper. It is customary on city lines to use wire insulated with a double braid of cotton thoroughly saturated with an insulating compound. Rubber covered wires for line work are of no use as the insulation will deteriorate in a comparatively short time, when exposed to all kinds of weather, rendering it worse than useless.

Tieing.—The line wire is secured to an insulator at each cross arm, being laid in the groove of the insulator and tied with a short length of wire about one or two gauges smaller than the line wire.

Jointing.—The ordinary twist joint is used except on very heavy wires of No. 000 gauge and over, when it is better to use a lap joint as it runs over the cross arms easier when the wire is being strung.

Dead Ending.—Lines are generally dead ended, on double cross arms, the wire being twisted round the insulators and then back on itself, and the tie wires soldered to the line wire

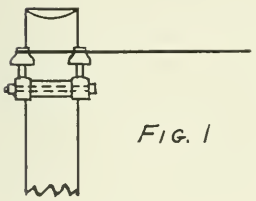
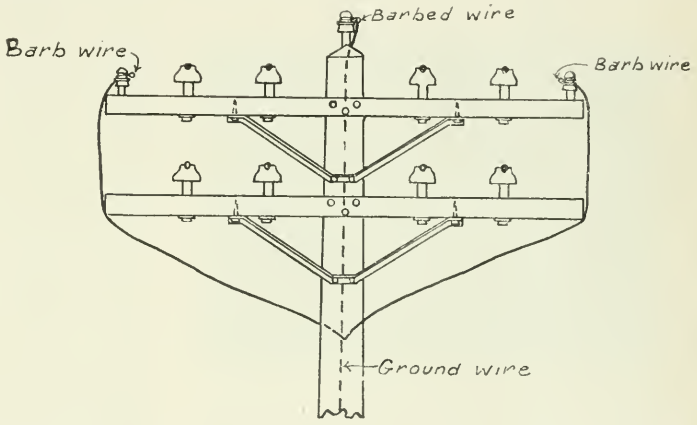


FIG. 1



on the last two or three poles. (Fig. 1.) For high voltage lines, a dead ending arrangement, consisting of a series of globe strain insulators is sometimes used, the line being fastened to one end of a string of strain insulators, the other end of which is bolted through the cross-arm as shown in Fig. 2. This system of dead ending is not altogether satisfactory, as the insulation of the strain insulators deteriorates and breaks down. Fig. 3 shows another method for dead ending high voltage lines, which has proved to be very satisfactory, although more expensive than that shown in Fig. 1. With this arrangement the wire is tied round two insulators, supported on a special iron bracket which is bolted through the cross-arm, the centre of the wire being in line with the shank of the bracket.

Stringing Wire.—Wire when strung is subjected to mechanical strains due to weight, tension, variations in temperature and additional weight in winter due to ice, and when stringing wire in our Canadian climate, special allowance must be made for variations in temperature. Dynamometers are not ordinarily used to determine the tension of the wire strung, but experience has shown what sags to allow between poles for different sizes of wire. The deflection of a wire supported between two points is given by the formula:

$$d = \frac{L^2 W}{8 T}$$

Where d = Vertical deflection at middle of span.
L = Length of span
W = Weight of wire in lbs. per ft.
T = Maximum tension of wire in lbs.

The length of a wire in a span is given by the formula:

$$L_1 = \frac{L + 8\,d^2}{3\,L}$$

Where L_1 = length of wire and L = length of span

$$\text{or } d = \sqrt{\frac{3L\,(L_1 - L)}{8}}$$

Stresses.—Pole lines are subjected to various stresses which have all to be provided for. These stresses are firstly, those due to the weight of the conductors and fixtures on pole, or the weight of ice on the conductors together with their weight tending to crush the pole, and secondly, those due to the lateral pressure of the wind on the pole and conductors,

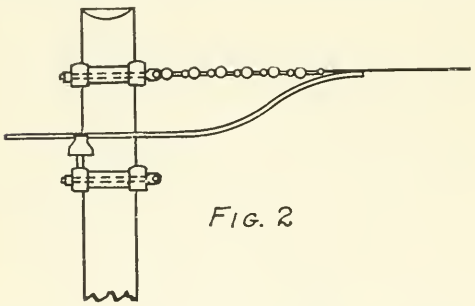


FIG. 2

tending to break the pole by bending; the action of the wind also has the tendency to break the pole near the ground due to vibration. The danger due to crushing is not very great, as there is always a very large factor of safety. On one of the heaviest pole lines in Montreal the factor of safety for crushing under ordinary conditions is about 400. Once during the winter, after a very heavy sleet storm, this factor was reduced to about 240, owing to the extra weight of ice on the wires. The stresses however, which are most to be feared, are those caused by wind. The same pole line mentioned was blown down in November last during a hurricane, about eighteen 70-ft. poles being broken. McGill Observatory reports gave the velocity of the wind at 75 miles per hour, which is equivalent to a pressure of 25 lbs. per square foot. This represented a total pressure on each stretch of this particular line, of 3,750 lbs., and there is no doubt if this had been applied as a constant pressure, that the poles and guys would have withstood same. However, the combination of the wind and the swinging of the wires evidently produced a strain in excess of the strength of the poles and guys.

Guying.—All lines require lateral support in the shape of braces or guys to withstand wind stresses, the poles themselves when loaded with wires being unable to withstand same. In the country, poles can be side braced with short wooden poles or guyed with anchor rods, but in cities this is impossible and guy wires have to be used. Galvanized iron or stranded steel is used for guy work, the stranded steel being preferable as it is much more flexible and its weight length for length considerably less. On long, heavy lines, poles in addition to being side guyed, should be guyed with crossed head guys every four or five stretches to prevent the line running back or the poles breaking, should any single pole in the line break or a stretch be cut or broken down. Where there are several cross-arms on a pole the "Y" guy is most useful, and at points where circuits dead end on one side of a cross-arm—"Y" guys should also be used to prevent the arms being twisted out of line. The practice of guying to trees and buildings should be avoided in all cases, for aside from making poor anchors for guys, they are subject to removal at a minute's notice from the proprietor and the company owning them is also liable for damages.

Lightning Protection.—The protection of aerial lines from the effects of lightning storms is a matter which has received considerable attention from all central station engineers operating overhead systems. With the advent of high tension transmission lines the difficulty of effectively protecting same has been greatly increased. Overhead systems may be affected in the three following ways:

(1) By direct strokes.
(2) By induced discharges.
(3) By electrostatic induction.

Fortunately for electric installations, direct strokes do not frequently occur, for probably no arrester would be of much service in preventing such a discharge from doing considerable damage. Induced discharges following a lightning flash and static charges, due to surrounding atmosphere being charged, are the conditions which have to be specially provided against. Owing to the high frequency of lightning discharges any inductance on the line offers an enormous impedence to a discharge, which fact accounts for the puncturing of transformer coils, the discharge taking the shortest and most direct path to ground. Arresters are non-inductive resistances, usually air gaps, one side being connected to the line and the other to earth, the resistance of these gaps being low enough for the lightning to choose same for a path to ground rather than through some of the apparatus connected to the lines. The length of the gap is governed by the working voltage of the line, the general practice of the day being to make it as small as possible without the ordinary current jumping across. However, this has the disadvantage that arresters are apt to be too sensitive and cause trouble, due to dust, cobwebs and dirt accumulating, or the fusing over of the spark gaps due to repeated discharges, thereby causing a short circuit on the line or a heavy ground, as the dynamo current follows the lightning discharge across the gap. A lightning arrester, in addition to affording a short path to ground, must also perform the duty of an arc breaking circuit breaker to immediately interrupt the flow of the line current to ground and extinguish the arc which is formed. Owing to the fact that any inductance in the line offers considerable resistance to the passage of a lightning discharge, choke coils are sometimes introduced in series with the line, between the arrester and the central station, the combination of arresters and choke coils forming a very reliable means of protecting the apparatus in the station. It is not a general practice to install a choke coil in conjunction with every arrester placed on the line, owing to the high cost which would be involved; however, it is a good scheme to place such a combination to protect any large and expensive apparatus connected to the circuits. These choke coils are usually constructed of flat copper strip wound on a non-conducting core, the layers being insulated with mica or some other insulator. Any self induction in the way of coils or turns in the ground wire of an arrester must be avoided, and when they are being put up, the linemen should be watched, as it is a favorite trick to take up any slack in a wire by making a little coil; any such coils would be nothing more or less than choke coils which would completely offset the value of the arrester, rendering it virtually useless. The ground wire is a most important feature in the installation of a lightning arrester and there is no doubt that many failures of arresters to protect lines are due to poor ground connections. To effectively protect a circuit,

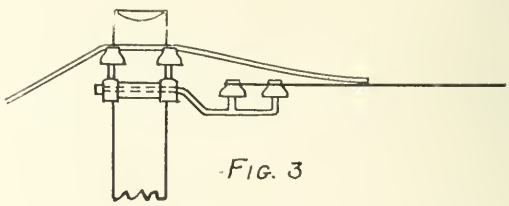


FIG. 3

DEAD-ENDING LINES

arresters should be placed at the end of all lines and at points where they branch off in different directions, and they should be inspected and cleaned from time to time. Despite the many devices used on the various types of arresters to extinguish the arc formed, the line current is occasionally not broken, thereby causing a short circuit or dead ground. To avoid this fuses are sometimes placed on the ground wire of single pole arresters, and in both leads of double pole arresters, this, however, makes it specially necessary that an inspection be made after every storm so that should any fuse be blown it can be replaced before the next storm.

Barb Wire.—Owing to the somewhat uncertain action on lightning arresters barb wire has been used on transmission lines

as a protection against lightning, and the results obtained have clearly demonstrated that it is a most satisfactory means of protection. Barb wire is usually strung on pins on top of the poles and also at the ends of top cross-arm. In some places a special two pin cross-arm has been used above the line wires, to carry the barb wires, and in other places a single line of barb wire is strung on top of the pole. Experience has shown that it is advisable to fasten the barb wire to glass insulators on pins rather than to staple it to the pole, owing to the superior mechanical support, the insulator of course not being used for insulating purposes. Some engineers consider that the trouble caused by using barb wire offsets its value as a protective device; and for that reason its use has been abandoned in one or two instances. A description of the methods adopted to protect the Chambly 12,000 volt transmission lines from lightning may be of interest, as the results obtained on the two lines have been eminently satisfactory. Two duplicate lines are run from Chambly to Montreal, the total distance being about 17 miles for each line, of which 14½ miles are aerial and 2½ miles underground cables. The underground cable is divided up in three sections, the first section being about a mile and a half from the power house, the second about fifteen miles from the power house, and the third at the Montreal end. The country through which the lines pass is very flat and marshy towards the Montreal end. Three lines of barb wire on glass insulators are run on each pole line as shown in Fig. 4, two lines being run on the ends of the top cross-arm about fifteen inches from the line wire, and the third on a pin on top of the pole. The barb wire is composed of two twisted No. 12 B.W.G. galvanized iron wires with one four point barb every five inches, and is connected at each pole by means of a soldered joint to the ground wire. This ground wire is stapled down the face of the pole and is twisted several times round the butt, after running through an iron pipe about eight feet long, which projects above the level of the ground, preventing the wire from being cut or broken, as well as affording an additional ground. The ground wire and pipe were stapled on the pole when the poles were being erected. As the poles on the transmission lines are set ninety feet apart the barb wire lines are grounded about fifty-eight times per mile; this frequent grounding being one of the most important points in the protection. It was the intention before putting the lines into use to place lightning arresters in addition to the barb wire, but as they were not available in time the lines were put into operation without them. Our experience with the first series of storms showed that well grounded barb wire was a very effective protection, and the lines were therefore operated under these conditions for one entire summer. Recently arresters of the air gap type have been installed at the power house at Richelieu as additional protection. During one particularly severe storm the local distribution lines in Montreal and Chambly, which were not protected by barb wire, were considerably affected, while no effects were felt on the transmission lines at all, although trees were struck in its immediate neighborhood. It was at first thought that the barb wire would rust and break down very quickly, but after two years' operation an inspection shows that it is in a very good condition, and as yet there has never been a single case of it breaking.

CONVERSION FROM CONSTANT ALTERNATING POTENTIAL TO CONSTANT ALTERNATING CURRENT.*

BY PROF. R. B. OWENS, MONTREAL.

For purposes of economic station operation as well as economy of copper in distribution, particularly in connection with water power developments, the use of large generator units of the alternating current type can be taken as standard practice. Assuming then an alternating current supply at constant potential, the several principal methods for its conversion for power interior illumination and street lighting may be recalled. For power, both the induction and synchronous motor under proper operating conditions are highly satisfactory. For interior lighting excepting of large areas, the use of constant potential transformers and incandescent lamps is practically universal. For street lighting, however, the case is different, there being little uniformity either as to apparatus employed or results obtained. The following are the methods principally in use:

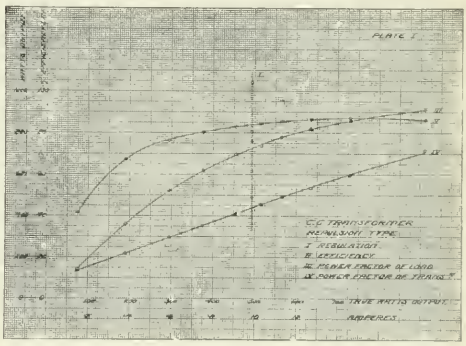
1. Induction or synchronous motors driving direct constant current open or closed coil, dynamos of different current capacities and open or enclosed direct current arcs, the latter type growing in favor.

2. A coil of constant or variable inductance in series with a circuit of enclosed alternating arcs, current being supplied from constant potential mains.

3. Constant alternating current transformers, usually of the repulsion coil type and enclosed alternating arcs.

Street lighting by constant potential alternating arcs and by incandescent lamps, while occasionally resorted to under special conditions, need not here I think be considered, the first because of low power factor, inconvenience of central control and low ratio of energy in arc to energy supplied to lamp terminals, and the second because of comparatively low candle-power—watt efficiency. In any system of arc lighting from an alternating current source considerations of efficiency, power factor and constancy of current in lamp are of primary importance.

With regard to the first method mentioned, namely, motor generator sets and direct current arcs, its chief drawback is low efficiency, little if any better than 75 per cent. under favorable conditions. As against this, however, must be counted the advantage it affords in the use of enclosed direct current series arcs, both photometric and power measurements showing their superiority to the alternating type. The line power factor also in general is good, being from 90 to nearly 100 per cent. at full load depending on whether induction or synchronous motors are used. The regulation of a modern direct constant current arc generator is likewise satisfactory.



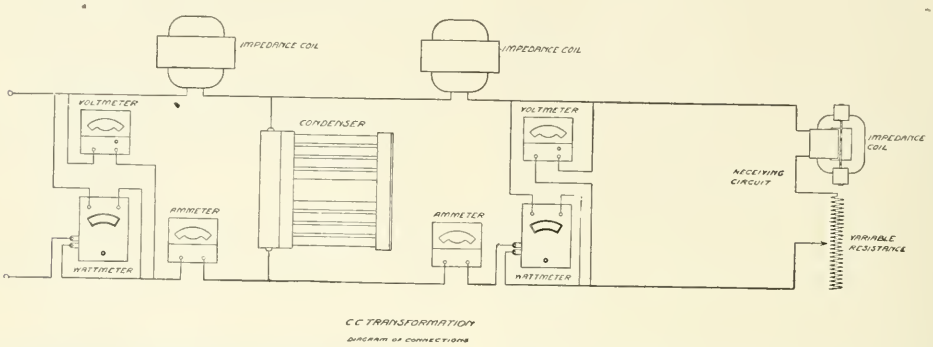
In the second method, if a large inductance is used, the power factor is poor and the regulation good, and conversely with a small inductance the power factor is good and the regulation poor. In practice it is found that a comparatively large inductance must be used to take care of possible short circuits on line which in general means poor power factor. The efficiency however is good at full load.

The third method, constant current transformers of the repulsion coil type and enclosed alternating arcs has come rapidly into prominence in the past two years, some thirty thousand series arcs being operated in this way at the present time. The special features of merits of this system seem to be high efficiency, close regulation, small space required as compared with motor generator sets, and the insulation of the arc circuits from the generator. The power factor is, however, poor, about 80 per cent. under favorable conditions at 60 cycles, and 70 per cent. at 125 cycles, and decreases rapidly with load. For purposes of comparison, I have shown in plate 1 the results of a test of a small constant current transformer—one k.w 1,000 volts, 1 ampere, of the repulsion coil type, not that the performance of so small a unit is as good as can be obtained in larger sizes, but, as all sizes possess certain characteristics in common, the results shown will serve our present purpose. Curve 1, plate 1, is the regulation curve and shows that with proper adjustment the regulation may be perfect. Curve 2,

* A paper read before the Canadian Electrical Association.

plate 1 is the efficiency curve, and shows that while the maximum efficiency is not high in this particular size, nevertheless a good efficiency is maintained throughout a considerable range. Curve 3, plate 1 is the power factor of load, and curve 4, plate 1 is the power factor of the transformer and load. It will be noted that the power factor of the combination is uniformly lower than the load power factor which is characteristic of all sizes within the limits of commercial practice. The particular object of the present paper is to emphasize another method of constant potential—constant current transformation which,

PLATE II

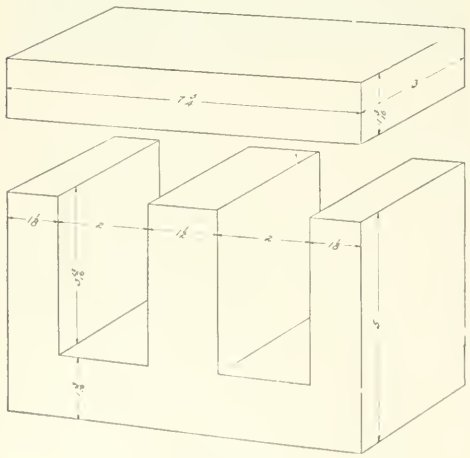


C C TRANSFORMATION
DIAGRAM OF CONNECTIONS

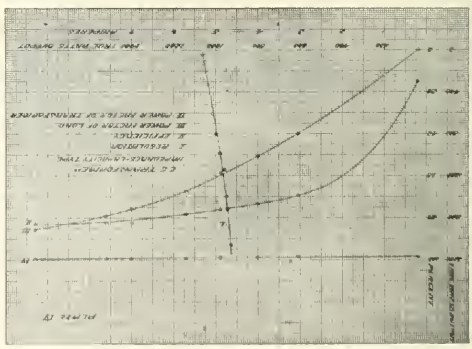
while known for some time,, has not apparently received the attention it deserves. I refer to the combination of impedence coils and condenser shown in plate 2, due originally, I think, to Le Blanc, and treated mathematically by Steinmetz and others. From the theoretical consideration it can be shown that when a constant potential is applied to two equal magnetic reactances in series with a variable non-inductive receiver circuit, the receiver circuit and one reactance being shunted by a condenser whose capacity reactance numerically equals either magnetic reactance the current in the receiver circuits will remain constant and be independent of the receiver circuit resistance. To test such an arrangement practically, two impedence coils, the dimensions and data of which are shown in plate 3, were constructed, their reactances being variable by the insertion of strips of rubber under their keepers, and connected in series with a smaller coil of constant reactance and a variable non-inductive receiver circuit. A 28 M.F. condenser shunted the receiver circuits and the two impedence coils. The reactance of the two coils in the receiver circuit was made as nearly as possible equal to the reactance of the remaining impedence coil and also of the condenser. Five hundred volts at 55 cycles was then applied to the main circuit and the efficiency and the power factor of the combination noted as well as the current in the receiver circuit. Plate 2 plainly shows the arrangement of apparatus and testing instruments. In plate 3 are given the results. As the power factor of the receiving circuits is varied from a small value to something over 80 per cent., it will be noted that the power factor of the main circuit remains throughout practically unity. The efficiency is nearly constant through a wide range although not high in this particular case, due to the design of the impedence coils. The regulation curve shows that the current in the receiving circuit varied only some six per cent. between half and full load, a sufficiently satisfactory result. Perfect regulation, however, can be obtained with better proportioned apparatus.

On the whole the results, though not as good in some particulars as can evidently be obtained after a full development of the system, are nevertheless, I think, of considerable interest to central station managers, as they clearly point to a method of constant potential—constant-current transformation possessing the characteristics of high efficiency, unity power factor, close regulation, absence of moving parts and requiring a comparatively small floor space. It is to be hoped that some of our larger makers will devote further attention to the method.

PLATE III



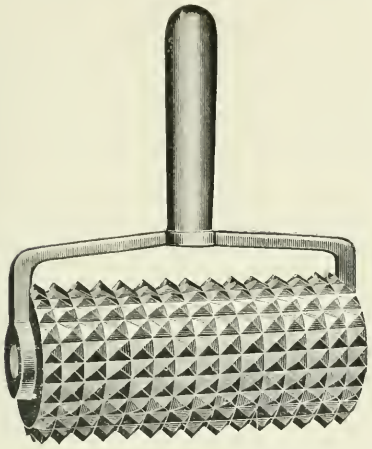
IMPEDANCE COIL
WOUND WITH 490 TURNS
NO 12 B&S WIRE
RESISTANCE .38 OHMS
16 MIL IRON



Charles S. Heurter, of New York, has been appointed assayer in the gold assay office the Dominion Government is establishing at Vancouver. J. E. Farquhar, of Vancouver, is named as assistant. G. W. Ryley, of the Interior Department, has gone west to make arrangements for the establishing of this new branch of the Government service. Thos. J. McCadrey, late manager of the Union Bank of Canada, will be business manager.

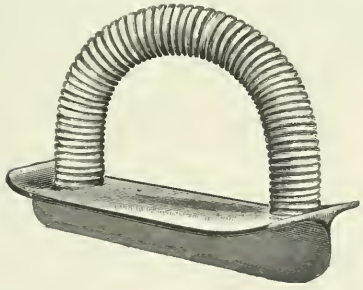
TOOLS FOR CONCRETE WALKS, ETC.

In Canada there is an increasing demand for finishing tools for concrete walks, artificial stone and cement work, and F. H. Crafts, assistant engineer of the New York State Corps, has designed a number of improved patterns, of which we illustrate two. The Dot Roller, manufactured from bronze, and used for giving sidewalks the appearance of being bush hammered, is made in four sizes, ranging from 3-in. to 3½-in. in diameter,



and from 4-in. to 12-in. in width, and is supplied either with a short handle, or long extension handle which slips over the short one. They are also made in different shapes, and used as line rollers for marking walks, stable floors, driveways, etc.

We also illustrate their improved Edger, which has a copper-ed steel wire handle, closely coiled, and the makers claim that the improved tools are superior to anything on the market. Their Canadian agents, the Yokes Hardware Co., Ltd., 111 Yonge street, Toronto, Ont., will send to interested parties a



complete catalogue and price list of these goods, and also furnish directions for making Portland cement and flagstone walks, curbs and steps, cement cellar floors, etc. The pamphlets will enable anyone, who follows closely the details and specifications contained therein, to turn out satisfactory work, at a far less cost than usual.

FRESH AIR FUND.

The Toronto Fresh Air Fund has entered upon its eighth year's work, and has for it object the sending away to the country for two weeks mothers and children who are badly in need of change. Good homes are provided, many of them on farms, and the children and parents are selected by the best known mission workers in Toronto. For mothers and babes unable to leave home, day excursions are arranged, and about one hundred at a time are taken to one of the parks on the lake shore, and before leaving for home, refreshments are served to them. Those wishing to help this good work may send money to the Rev. H. C. Dixon, room 6, 15 Toronto street, Toronto.

Industrial Notes.

The contract for the Winnipeg waterworks improvements has been let to A. H. McAlpin, of Columbo, O.

It is reported that the Canada Cycle & Motor Company will remove several of its departments to Hamilton.

The Canada Switch & Spring Company, Ltd., Montreal, Que., contemplates adding an open hearth steel plant to its works.

The Canadian Composing Co., of Montreal, has received an order from Australia for 40 Monoline type-setting machines.

The ratepayers of Chambly, Que., voted a bonus of $20,000 to the Canadian Aluminum Works, and $25,000 to the Davies Rubber Tire Company.

The Dominion immigration department is endeavoring to attract to Canada the Indiana glass manufacturers, whose full supply of gas is running out.

The affairs of Taylor Bros., brick and paper manufacturers, Don Valley, Toronto, have been straightened out, and show assets of $80,000, and liabilities of $134,523.

Chicago capitalists are interested in the development of the Koochiching Falls at the outlet of Rainy Lake, Ont., and may establish a pulp mill on the Canadian side.

Baker & Co., of Newark, N.J., metallurgists in platinum, are presenting their customers with a useful and attractive advertising novelty in the form of a dating stamp.

Pictou, N.S., is establishing waterworks. T. A. McLean & Son, Charlottetown, P.E.I., have the contract for the stand pipe, and McDonald & Fraser, of Pictou, for the artesian well.

The Bailey Cutlery Company, of Brantford, Ont., wants to extend its business, and has asked the City Council to give another addition to its already large factory, which is owned by the city.

Russian and German officials have gone to Sydney, C.B., to inspect the works of the Dominion Iron and Steel Co. They will present a report to their respective governments on the question of purchasing iron and steel here.

The Nova Scotia Steel Company has passed out of existence, and is succeeded by the Nova Scotia Steel & Coal Company. The capital of the new company is $9,500,000. The directors of the old company were elected as directors of the new.

A new scheme to supply Montreal with cheap power and pure water is announced by James Wilder of H. A. Wilder & Co., Montreal, who says he is backed up by New York capitalists, and who claims the power will be generated by the compressed air process.

Galt is considering a bonus of $15,000 to a new company being formed, called the Maple Leaf Harvest Tool Co., with a capital of $100,000, which propose to spend $65,000 on buildings and machinery, and will employ about 60 men. The promoters of the company are Shurley & Dietrich, F. Palmer, W. Jauney and O. Vogt.

The Wire Nail Manufacturers' Association of Canada held a meeting in St. John, N.B., on the 25th ult. Nearly all the factories in Canada were represented. It was decided that the prices current since the first of the year should be allowed to stand as the situation was considered satisfactory. The manufacturers of cut nails, tacks and screws decided to make a slight advance in cut nails.

The Cramp Ontario Steel Co., of Collingwood, has been taken over by the Cramp Steel Co., Limited, with a capital of $100,000,000. The new works recently begun will be speedily completed. About 899 acres of iron land have been secured in Parry Sound district, close to Collingwood, and the new company likewise has secured 10,000 acres of coal land in Wise county, Virginia. Mr. Cramp intends to reside in Collingwood, and to dispose of some of his United States interests, in order to devote himself to the newly formed company's interest.

The Canada Switch and Spring Co. are building an extension to their works in Montreal.

D. D. McDonald and Malcolm Cameron are opening a broom and brush factory at Cornwall, Ont.

The Ouiatchouan, Que., Pulp Co. has placed orders for two 1,000-h.p., one 500-h.p. and one 100-h.p. turbines to operate its new pulp mills.

The Hamilton Facing Mill Co., Hamilton, are agents in Canada for the sale of the iron cements of the Smooth-On Mnfg. Co., referred to in another column.

Smith & Aldrich, civil engineers, Toronto, have prepared plans for new sewage works for Cobourg and have charge of construction of the same. Operations have begun this month, and there will be five miles of sewers, costing about $20,000.

The Canada Radiator Co. have purchased the Consumers Cordage Co.'s factory building at Port Hope, and have started there a large foundry for radiators. The new factory was opened in May with very good prospects. The company retains its office and warerooms at 124 Bay street, Toronto.

Personal.

J. T. Burke, Stratford, Ont., will succeed R. Barber as factory inspector.

Geo. W. Dawson has been promoted from second engineer to chief engineer of the Hamilton distillery.

H. Sapery, of the Syracuse Smelting Works, Montreal, has returned from a very successful trip to the Pacific Coast.

J. F. Carter, formerly with the Waterous Engine Works, Brantford, has been appointed assistant superintendent of the Canada Foundry Company's big works in Toronto.

M. E. Wallace, of the Hamilton branch of the Westinghouse Company, has been appointed superintendent of the establishment at Pittsburg. His successor at Hamilton is Percy Domville.

H. A. Higgins, the general manager of the Standard Tool Co., Cleveland, O., sailed for England, May 15th, to visit the foreign representatives of his company in England, France, Germany, Russia and Scandinavia.

J. Frank Cody, marine engineer, has been transferred to the marine oil department of the Standard Oil Co., of New York. Mr. Cody's headquarters, hitherto in Canada, will now be at some point in the United States.

J. H. Drury, of the Brown & Sharpe Mnfg. Co., Providence, R.I., and S. H. Warnock of Lamplough & McNaughton, Canadian agents for the Tandem Anti-Friction Metal Co., were in Toronto, and visited our offices during the month.

W. R. Russell has resigned the superintendency of the Quebec Railway Light & Power Co., and J. A. Everett is appointed superintendent of the Montmorency & Ste. Anne divisions, with H. N. Bartlett in charge of the citadel division of the electric system.

Charles Booth, C.E., has resigned his position as town engineer of Westmount, Que., and now has charge of location of the line of the Cape Breton Railway Extension Co., from St Peter's easterly. Fred L. Fellowes, C.E., of Montreal, succeeds Mr. Booth at Westmount.

W. F. Creighton has resigned his position in the advertising department of the C.P.R., and has taken a more lucrative post in the advertising department of the I.C.R., with headquarters at Moncton, N.B. He was the recipient of several handsome presents on the occasion of leaving the C.P.R.

Wm. Golding, a well known mechanical engineer of New Orleans, and a former resident of Ontario, died recently. He contributed several articles to the Canadian Engineer. He was an expert in marine surveying and his wide general knowledge was always at the service of those who sought it.

D. Laine, of the well known engineering firm of Carrier, Laine & Co., Levis, Que., dropped dead on the 28th ult. just after eating dinner. Mr. Laine was a man of unassuming disposition, and highly esteemed. He was born at St. Gervais, and was one of the founders of the firm in 1864. He was a member of the Council of Arts and Manufactures of the province, and was a member of the town council since 1880.

Wm. Wallace of the well-known firm of John Brown & Co., Ltd., Atlas Steel Works, Sheffield, has been on a visit to Canada. This company are large manufacturers of armor plate, marine furnaces, car axles, railway springs and tires, cylinder teeth for threshing machines, steel for electrical work and induced draft appliances.

Paul Armstrong, secretary and treasurer of the Armstrong Bros. Tool Co., of Chicago, stopped off at Toronto on his way home from the annual convention of the Master Mechanics and Carbuilders, at Saratoga. The Armstrong patent tool holders are being rapidly adopted in the best railway shops of the continent, and reports to Mr. Armstrong from this field of work at the convention are gratifying to the company.

Cecil B. Smith, Mem. Can. Soc. C. E., assistant engineer, city engineer's department, Toronto, Ont., and formerly assistant professor of civil engineering, McGill University, and William S. Aldrich, Mem. Am. Inst. E.E., Mem. Am. Soc. M. E., professor of electrical engineering, University of Illinois, have formed a partnership and opened offices as consulting engineers, rooms 101-103 Mail and Empire Building, Toronto. Prof. Aldrich, though young in years, is one of the best teachers of the electrical science in the United States, and is almost equally well known in the field of mechanical engineering. Our readers are already familiar with Mr. Smith's work, and will agree that these two gentlemen will make a strong team.

W. H. C. Mussen, who is starting business in railway, mining and contractors' supplies, under the title of W. H. C. Mussen & Co., at 763 Craig street, Montreal, has had a long experience in all branches of the business. In 1886 he joined the Cooper, Fairman Co., and on the dissolution of that firm, continued with James Cooper. For many years he was secretary-treasurer of the Dominion Wire Rope Co., and also of the Linde British Refrigeration Co., and treasurer of the James Cooper Mnfg Co. He was in charge of the financial part of James Cooper's business of railway and mining supplies. Two years ago, he gave up all this work and devoted his energy to the selling department of the railway and contractors' supply business of the same firm. Mr. Mussen brings to his new venture much skill and experience, which with the good wishes of his friends, ought to ensure him success.

Electric Flashes.

The Victoria, B. C., electric railway is being extended at a cost of $100,000.

The Montreal Street Railway Company has purchased the Park and Island Railway, composed of suburban lines, for $1,100,000.

The Summerside Electric Co., Summerside, P.E.I., have ordered a 150-h.p. Mumford boiler from the Robb Engineering Company.

The Jones & Moore Electric Co. have been awarded the contract for the lighting equipment of the new steamer "Algoma."

The British Columbia Electric Railway Company Vancouver, is enlarging its power-house, and putting up a new bridge over False creek.

The Jones & Moore Electric Co. are building a 250-light incandescent dynamo for the Schofield Woolen Co., of Oshawa, to replace their old plant.

The Manhattan General Construction Co., manufacturers of the Manhattan arc lamp, have moved their New York offices from 11 Broadway to 120 Broadway.

The Chambly Manufacturing Company has entered an appeal from the judgment of the Superior Court, Montreal, in its action against the Stillwell Bierce and Smith Vale Company. The company has also entered an appeal from the judgment in the action taken against it by S. T. Willett.

The city of Kamloops, B.C., has ordered two 150 h.p. Mumford boilers from the Robb Engineering Co., for their waterworks and electric lighting system.

R. B. Wass has purchased the electric light plant of Oakville, Ont., formerly owned by the late C. M. B. Lawrence, of Stratford. Mr. Wass took possession in May last.

The Jones & Moore Electric Co., Toronto, are placing on the market something new in the way of direct connected dynamos, a full description of which will appear in our next issue.

The Nova Scotia Steel Co. are increasing the electric lighting plant at their works, New Glasgow. The extra power will be supplied by a 100-h.p. Robb-Armstrong engine, with direct connected dynamo.

The Parry Sound town council may dispose of their recently acquired power plant to a new company, called the Seguin Power Co., Ltd., of Parry Sound, with $40,000 capital. The new company propose to supply power to industrial works which they will assist in promoting.

The Cape Breton Electric Co. has taken over the Sydney Gas and Electric and Sydney Ferry companies. The following are the directors of the Cape Breton Electric Co.: E. F. Webster, president; E. Wadsworth, sec.-treas.; G. R. Fearing, jr., J. N. Armstrong, W. C. Forbes, J. E. Burchell, B. F. Pearson.

The special telephone committee of the Toronto city council is considering the offer of the Ontario Telephone Company to install an up-to-date system, underground, in the centre of the city, and give each subscriber a metallic circuit, the cost to be $30 per annum for business 'phones, $24 for house 'phones, and the two for $50. A draft contract is being prepared, which if acceptable to the company, will be sent on to council.

At the annual meeting of the Imperial Electric Light Company, Montreal, a dividend of 7 per cent. was declared. The following were elected directors: Victor Morin, president; Rod. Tourville, vice-president; Dr. E. R. Chagnon, treas., E. J. Chapleau, managing director; Arthur Tourville. A resolution was passed expressing the company's appreciation of the services of Jules Bourbonnière, secretary and manager, who leaves this month to start business for himself.

The annual report of the Ottawa Electric Company shows a gross revenue for the past year of $196,363, an increase over the previous year of $19,680, which was more than counterbalanced, however, by the increased expenditure, incident to obtaining temporary power and additional plant, after the great fire. The company's net profit amounted to about $27,500. The following were re-elected directors: T. Ahearn, president; F. P. Bronson, vice-president; Hon. E. H. Bronson, Hon. F. Clemow, John Coates and A. Lumsden, M.P.P.

W. C. Hawkins, formerly with the General Electric Company at Schenectady, N.Y., has been appointed general manager of the light and power departments of the Hamilton Electric Light and Cataract Power Company. H. R. Leyden has not yet completed all the work of construction and installation, but expects to get through before fall. Gordon Henderson is still connected with the lighting department. The company's railway lines will continue to be under Clyde K. Green.

The Franklin Institute of Philadelphia issues each year a premium and gold medal, which are awarded for the most noteworthy achievement in electrical science during that year. This is known as the John Scott Premium and Gold Medal. The award for this year has been made to the General Electric Co. on account of their series alternating system of street arc lighting. During the two and a half years the system has been before the public, 230 central stations have ordered 22,000 arc lamps on this system, distributed in all parts of the world.

The tenders for the civic lighting contract of Montreal have agitated electric circles a good deal during the past month. At the meeting of the Fire and Light Committee on the 21st, a motion to award the contract to the lowest tenderer was voted down, and it was decided to send the six tenders on to the council for that body to choose. The city electrician read a report giving figures based on steam as a motive power, and was of opinion that 1,500 lamps could be supplied at $72.44 each per year. The tenders submitted were as follows, the quantities being 1,300 lamps of 2,000-c.p. each, and the term being five years: Standard Light & Power Co., $90 per lamp per year; Royal Electric Co., $95; Lachine Rapids Hydraulic & Land Co., $90; Imperial Electric Co., $85; Shawinigan Falls Co., $79.93½, and St. Lawrence Power Co., $54.75. There is a fear that the council will not decide the question on the principle of giving the contract to the lowest tenderer, and two public meetings have been held protesting against the manoeuvring of the Montreal aldermen. Meantime the Shawinigan Co. and the St. Lawrence Power Co. are seeking permission to enter the city to distribute light and power. At an adjourned meeting on the 10th inst., it was decided, by a majority of one, to defer action till September.

The Court of Appeal, Montreal, has confirmed the judgment of a lower court, against the Royal Electric Co. for $5,000 damages to the widow and children of a hotelkeeper, named Girouard, who was killed by taking hold of an electric lamp. The court held that the company was bound to provide a safe current for the lamps installed in the premises. It was supposed that during a rain storm an unusual current escaped to a frayed wire leading to the house from a point just below the transformer, or that at the time the deceased took hold of the lamp the wire got some or all of the current from the Lachine Rapids feed wire, which passed near. At all events the burden of proof was upon the company to show that the leak of current did not come from their wires.

In the Superior Court of Quebec, Judge Andrews has rendered judgment in favor of the Quebec Railway, Light and Power Company (formerly the Montmorency Company), in the famous case brought by it against its local rival, the Jacques Cartier Water Power Company, disputing the right of the latter to supply electric light and power to the city and neighborhood, and to erect poles in the streets, and especially complaining of the obstruction and danger to its plant and property caused by the works, poles and wires of the Jacques Cartier Company. The charter rights of the latter were subsequently admitted, but the question of the danger to the plaintiff's plant was submitted to experts, upon whose report His Honor decided that within three months the Jacques Cartier Company must remove all its wires, poles and other constructions wherever they are in dangerous proximity to the other company's plant. Notice of appeal has been lodged.

Railway Matters.

The car shops of the Canadian Northern at Winnipeg are to be enlarged.

The New Brunswick Coal & Railway Co. will soon call for tenders for the line from Chipman to Gibson.

The annual report of the Quebec and Lake St. John Ry., shows quite a development in the trade of the Lake St. John district.

The C.P.R. intend ths year to build extensions of the Snow Flake and McGregor branches and a branch northward from Brandon.

A start has been made at Roberval on the building of the first 10-mile section of the Quebec & James' Bay Ry., which will hereafter be known as the Trans-Canada Ry.

A new railway 48 miles in length, is to connect Republic, Wash., and Grand Forks, B.C., to enable the American mine owners to carry their ore to the Canadian smelter.

The Chateauguay & Northern Ry. Co. have let to Smith & Abbott, of New York, the contract for building the line from Montreal to Joliette, and to the Dominion Bridge Co. for the bridges, including the big bridge over the Ottawa. The total of the contracts is about $1,000,000. The road will enter Montreal at the east end.

A railway to connect Shemogue, New Brunswick, with the Intercolonial Railway at Shediac is being promoted. A survey has been made, and the line located from Shediac to Shemogue, a distance of 20 miles, and it is intended to continue it some 18 miles farther towards Cape Tormentine, on the Northumberland Straits, if a subsidy for the last 18 miles can be secured from the New Brunswick Government.

A. J. Gay has struck a rich flow of oil in the foothills not far from the Kootenay lakes.

Mining Matters.

The provincial assay office, Belleville, reports that a deposit of iron pyrites in North Hastings is being developed, with every prospect of becoming a shipping mine.

It is rumored that the Standard Oil Co. has acquired the oil wells in Inverness county, Cape Breton. The oil has been tested, and is of excellent quality.

A company of American and Canadian capitalists, with H. P. R. Brumell of Buckingham, as Canadian manager, has been organized to develop the graphite properties in Labelle county, Quebec.

The Richardson Gold Mining Co. has ordered a 100-h.p. Mumford standard boiler from the Robb Engineering Co., for their mine at Isaac's Harbor, N.S. This is the second of these boilers bought by them within a few months.

W. Callander, of Canmore, B.C., has obtained some fine specimens of mica from a ledge 30 feet in thickness on the Columbia River, B.C. The ledge has been traced over a great extent of country, and is believed to be a rich strike.

Olaf Pary has discovered an extensive nickel mine in the Canadian Yukon. There are four claims, each 1,500 feet square, and the ore is reported so abundant that it would seem inexhaustible. It has assayed 4 per cent. nickel.

The Moncton Times says the Canadian Coal and Manganese Co., Ltd., have exposed a seam of coal on their property near Coal Branch, N.B., that has a foot wall of fire clay. This indicates bituminous coal, which was not supposed to exist in New Brunswick.

The Ontario Graphite Co., of Ottawa, are installing a 500-h.p. generator on the Madawaska to operate a mining plant at Black Donald, two miles distant. The plant at the mine consists of a six drill air compressor plant and a refinery for the ore. When completed it will turn out 20 tons per day.

At the annual meeting of the Dominion Coal Co. in Montreal, the company's output of coal was reported at 1,730,374 tons for 1900, and 2,044,877 tons for 1901, with an estimated yield of 2,600,000 for 1902. H. M. Whitney was re-elected president, and James Ross is general manager.

The refining of nickel has commenced at Dr. Ludwig Mond's works at Victoria Mines, Algoma. Dr. Mond's smelter refines to about 80 per cent. metallic contents, the remainder of the refining being done at his works in England. The Orford Copper Company at Sudbury also refine to 80 per cent. in their new refinery.

Major Wood, who has come down from the Yukon, estimates the yield of gold there this year at $25,000,000 or $5,000,000 more than last year. An important find of copper has been reported between the Hootalinqua and the south fork of the Big Salmon. The ledge of quartz is 50 to 500 feet wide and rich in copper. It may be a continuation of the White Horse copper belt. Eight other quartz ledges have been found in this district since.

A serious fire destroyed the main shaft building at the copper mines, Bruce Mines, Ont. The loss is upwards of $35,000; insurance, $20,000. The plant destroyed was one of the best examples in Canada of a modern mining equipment. The boilers, warehouse and other buildings adjacent were saved. The company's recently completed concentrating mill only started on May 1st, 250 tons of ore per day were being treated, and about 250 men were employed. The plant will be immediately reconstructed.

A noteworthy find of oil has been made by the New Brunswick Petroleum Co., on ground in the Westmoreland, N.B., oil belt belonging to St. Joseph's College, near Memramcook. The oil obtained is a dark brownish green color with pronounced fluorescence and crude petroleum characteristics. It is free from empyreumatic odor, and the specific gravity tested at 60 Fahr was 0.80 (water 1.00). The gravity of American crude oils runs from 0.70 to 0.88, and the new find is pronounced equal to the Pennsylvania Black Sands product. These oil fields are estimated to underlie 18,000 square miles, from the Bay of Fundy to Bay Chaleur.

Mr. Owen, an extensive slate owner from North Wales, is visiting the Newfoundland slate quarries, with his foreman and a staff of skilled slate explorers. Should the slate beds be satisfactory he will bring out a colony of Welshmen to open out the industry on the Island.

Dr. Robt. Bell has been appointed acting director of the Geological Survey, in succession to the late Dr. Dawson. Prof. Eugene Haanel, who has been head of the Department of Physics in Syracuse University for 13 years, has been appointed superintendent of mines in Canada in succession to William Pearce.

F. H. Clergue, of the Lake Superior Power Company, has, it is said, secured the right of a syndicate which controls the immense deposits of manganese and other minerals in the Magdalen Islands. The geological formation of the islands is identical with the South Batesvelle district of Arkansas, hitherto one of the greatest producing centers of the mineral.

SEWAGE DISPOSAL.

BY R. S. LEA, MA.E, M. CAN. SOC. C.E.

(Continued from June number).

In the diagram (see June), "freshly dead organic matter" is shown to right of the vertical center line. As we have seen it consists almost entirely of the four elements, carbon, hydrogen, oxygen and nitrogen, combined in a great variety of ways. As we have also seen, it is this complicated arrangement of the atoms, and the relatively small proportion of oxygen, which constitutes the difference, from a chemical point of view, between organic matter and the simple inorganic substances from which it was built up. The following table (1) by Dibdin shows the actual character of six typical organic substances:

TABLE I.

Substance.	Percentage of Nitrogen.	Hydrogen.	Oxygen.	Carbon.
Gelatine	18.3	6.6	25.1	50.1
Chondrine	14.4	7.1	29.4	49.1
Albumen	16.0	7.1	22.0	53.0
Cellulose, hardy fibre	....	6.2	49.4	44.4
Starch	....	6.2	49.4	44.4
Fat, stearic acid	....	12.7	11.3	76.0

Compounds, like the first three, containing nitrogen, are characteristic of organic matter of animal rather than of plant origin, and are capable of more offensive decomposition. They all contain oxygen, but in relatively small proportions, as will be seen by referring to the chemical formulæ of the inorganic substances from which they are derived. The additional amount, which is required to completely oxidize the carbon, hydrogen and nitrogen, is given in table II., which follows (also by Dibdin).

TABLE II.

Pounds of oxygen required to oxidize every 100 lbs. of substance:

Substance.	OXYGEN REQUIRED By the Nitrogen.	By the Hydrogen	By the Carbon	Total Required	Oxygen already present	Difference or additional Oxygen, required for complete oxidation of substance.
Gelatine	52.3	52.8	133.3	238.4	25.1	213.3
Chondrine	41.1	56.8	131.0	228.9	29.4	199.5
Albumen	45.7	56.8	141.4	243.9	22.0	221.9
Cellulose	49.6	118.4	168.0	49.4	118.6
Starch	49.6	118.4	168.0	49.4	118.6
Fat, stearic acid.	101.6	202.5	304.1	11.3	292.8

The small proportion of mineral matters present in these substances is of no importance in this connection, and may be disregarded.

This table shows that the proportion of oxygen in fat, for instance, is so small that nearly three times its own weight of oxygen is required for its complete oxidation. Considering the fact that five cubic feet of ordinary air contains about one cubic foot of oxygen, the above table will give some idea of the quan

tity of air necessary in some of the purification processes to be presently described.

The complex molecular structure of these organic compounds produced in the processes of deoxidation, has been obtained at the expense of stability, and this implies the existence of a continual tendency towards a reoxidation of the elements whenever the combinations in which they may be held are broken up. How to produce this in the most direct and economical manner is the object to be aimed at in any system of sewage purification.

If the temperature of an organic substance is raised to what is termed its kindling point; in other words, if it is set on fire, the oxygen of the atmosphere will combine with it, and in this manner its oxidation will be accomplished—the liberated energy manifesting itself in the form of heat. If certain chemicals are brought in contact with it, such as the permanganates, oxygen is set free in the nascent condition, and will combine with it, and so bring about its complete oxidation. Such violent methods are, however, impossible or difficult to accomplish on any considerable scale, as well as uneconomical. Though, in a sense, accomplishing the same object, they are obviously entirely different in method from the mild and equable processes which nature has provided for the removal of the vast quantities of animal and vegetable wastes which are produced from year to year.

Bacteria.—These natural forces, which can bring about the oxidation of organic matter even more effectively than those of heat or chemical energy, exist in the bodies of the smallest and humblest of living organisms. These are the bacteria, or microbes, or germs, as they are variously called, which exist in the surface waters, in the air, in the upper layers of the soil; in fact, wherever they are needed. They are of the very simplest structure, consisting of but a single cell, and are of almost inconceivable minuteness. A faint idea of this may be obtained from the fact that a sphere 1-25 of an inch in diameter could contain 500 millions of the larger ones, and it would take more than a thousand of them, placed in a row, to reach across the diameter. Yet, they have been studied and classified into hundreds of different species, whose habits of life, characteristic products, form, etc., are now well known. While individually insignificant, it is only necessary to consider the enormous quantity of waste material which they are constantly disposing of in order to see how important are the results of their aggregate action.

In shape they are spherical (the cocci), rod-shaped (the bacilli), spiral-shaped (the spirilla). That they may exist in a flourishing and active condition, certain attendant circumstances are necessary, such as presence or absence of air or light, a certain degree of warmth, moisture, etc. As we shall see, they constitute to a great extent the "forces of nature," which the engineer engaged in the problem of sewage disposal must "direct to the use and convenience of man." Other facts relating to them, which are of importance in this connection, are as follows: They are possessed of enormous vital activity, and in the presence of dead organic matter and other favorable conditions, are capable of multiplying with almost incredible rapidity, so that their action is to a certain extent, automatically adjusted to the amount of work they have to perform. It was at first doubtful whether they should be classified as plants or animals; but it is now definitely decided that they belong to the class of colorless plants. They reproduce by fission—a simple process by which a single bacterium divides itself in the middle, thus producing two. An exceedingly small proportion of them, which includes the pathogenic or disease-producing germs, are parasitic—that is, they exist upon or in the body of a living host. But the great majority are saprophytic, which means that they live upon dead and decaying organic matter. A few species are able to exist either as saprophytes or parasites, and are called facultative.

Another classification depends upon their ability to live in the presence or absence of free oxygen, e.g.:

1. Aerobic, requiring the presence of oxygen.
2. Anaerobic, unable to exist in the presence of this gas

Facultative anaerobes, which occur in sewage in large numbers, can live either with or without oxygen

By their methods of obtaining their food, or by the products of their life and action, the saprophytic bacteria—aerobic and anaerobic—are enabled to break up the complex molecules of organic compounds into simple ones, and ultimately bring about their complete oxidation. The process is a gradual one, and is accomplished in successive steps by different groups of bacteria, many of which can act upon the organic matter only when it has been transformed by passing through certain preparatory processes, which have been effected by other groups It is by reason of this consequent division of the work, together with the fact that the chemical products of one species are often inimical to the life of another, or even to its own when greatly accumulated, that it is possible to modify and largely intensify their action by a certain degree of artificial regulation and control.

Decomposition.—The process may be followed with the aid of the diagram, but it must be remembered that it is a very intricate one and that, therefore, it is possible to show only the most important of the changes which take place, and the order in which they occur.

If the waste material (freshly dead organic matter), is exposed to the atmosphere under such circumstances as will permit all parts of it to have free access to the air, it is immediately attacked by numerous members of the aerobic group of bacteria, which, if other conditions are favorable, thrive and multiply with great rapidity. Besides obtaining the means of supporting their own existence, they cause, by their action in doing so, a breaking up of the chemical combinations of the organic substances whereby the oxygen of the atmosphere is enabled to combine with the carbon of the compound, producing carbonic acid gas. The oxidation of carbon leaves the nitrogen and hydrogen to unite in the form of ammonia, or of various ammoniacal salts.

This process, the intermediate steps of which are very complicated, and imperfectly understood, is indicated in the diagram by the outer path connecting "freshly dead organic matter" with "ammonia, etc." If the supply of oxygen is not interrupted, a further oxidation of this "ammonia" will take place, the hydrogen to water, and the nitrogen to nitrites and nitrates. This is brought about by means of other species of aerobic bacteria belonging to what is called the nitrifying group. Some of these (the nitrous organisms), can thus change ammonia ($N H_3$), into nitrous acid ($H N O_2$), while others (the nitric organisms), complete the oxidation to nitric acid ($H N O_3$). These acids combine with any bases present, such as soda, potash, lime, etc., to form nitrites and nitrates. This oxidation of the nitrogen of ammonia is known as "nitrification," and is thus the work of certain specific organisms. It has been studied very carefully in connection with the experiments on intermittent filtration of sewage, made by the Mass. Board of Health, the results of which are very fully set forth in its reports. Its action, shown by the production of nitrates, appears to proceed to a certain extent coincidentally with the oxidation of the carbon, and is very susceptible to temperature conditions, the supply of oxygen, overworking the filters, and other circumstances. The nitrates, which, with the water and carbonic acid, represent the final products of this whole process of decomposition, are purely mineral substances, completely oxidized and entirely without energy. These operations, therefore, represent the complete destruction of organic matter, by its successive conversion into substances of less and less complexity of structure, but of greater and greater stability, until it is finally resolved into the water, carbon, dioxide, and nitrates out of which it was originally built up, and in which form it is again available for use in the structures of other plants and animals.

These operations, which are truly as old as the hills have always been familiar to us, though until very recently entirely misunderstood. The changes taking place were thought to be purely chemical and brought about by mere exposure to the air, or, as in the case of the rapid disappearance of manures in cultivated lands, by the action of the growing plants, and of the soil itself. This view is now known to be entirely incorrect and it has been repeatedly shown that, however abundant the air supply, no decomposition can take place without the presence of bacteria. On the other hand, as we shall presently see, certain of these micro organisms are able to set up a process of decomposition in organic matter, and even produce a certain amount of oxidation, under circumstances where air is carefully excluded.

Putrefaction.—It is decomposition under such conditions as these which we shall next consider. The breaking up of the organic compounds is now brought about by various species of the anaerobic bacteria, which find in the exclusion of air and light just the conditions necessary for their development. Their action does not proceed with the same outward simplicity as that of the aerobes, but is accompanied with the production of offensive odors, noxious gases, and other disagreeable manifestations characteristic of what is termed putrefaction.

It is this kind of decomposition that goes on in organic deposits at the bottom of stagnant pools, in cesspools, and the like—and wherever nitrogenous organic matter is prevented from having access to air. Even when the decomposition is to ontward appearance entirely aerobic, the preliminary disintegration which enables the air to get free access, must often be of this nature.

The chemical changes are entirely different from those taking place in aerobic decomposition. Certain species of the anaerobes have the power in the presence of organic matter of de-nitrifying nitrites and nitrates—that is, deoxidizing them. When the circumstances are favorable to such action the nitrogen is set free as nitrogen gas, while the oxygen attacks the organic matter, bringing about the formation of carbon dioxide and other gases. The chemical changes are at first, however, especially in the case of sewage, of the nature of what the chemists term hydrolysis, or the breaking up of organic compounds by the action of water. This action often results in the liquefaction of refractory and otherwise insoluble substances, like fibrin or cellulose, which process is accompanied by the formation of many gaseous compounds of carbon, hydrogen and nitrogen. These, and many other chemical changes, which take place according to the attendant circumstances, are described in detail by Dr. Samuel Rideal in the Journal of the Society of Arts.* Referring to the anaerobic decomposition of the organic matter in sewage, he says: "Very similar changes, mainly hydrolytic, are accomplished by the large class of organic substances called 'enzymes,' which, though not living, are products of animal and vegetable life. . . . Their importance to us is shown by the fact that a large number of them are the products of the bacteria or other fungi, and are powerful agents in their resolving action. By their means a bacillus is not only able to act in its immediate neighborhood, but also at a considerable distance, through the soluble ferments it forms and disengages."

As indicating the complex nature of the process his chemical classification of the "fermentations which occur in the first or hydrolytic part," is quoted as follows:

"1. The solution and decomposition of albuminous bodies.

"2. The fermentation of urea.

"3. The fermentation of amido-compounds formed from the albuminous bodies.

"4. The formation of organic acids and the fermentation of their salts.

"5. Cellulose or methane (CH_4) fermentation.

"6. The hydrolysis of carbohydrates (sugars, fats, etc.).

"7. The formation of small quantities of sulphur compounds, like H_2S, mercaptan, etc. This from the odor of the products often attracts the most attention."

This process is indicated in the diagram by the first part of the inner path connecting "freshly dead organic matter" with "ammonia, etc." It takes place very rapidly, as compared with purely aerobic processes, and results in a very considerable reduction in the amount of organic matter, in the formation of volatile gases, etc. Though the changes which have taken place are in the right direction, the process of decomposition is as yet very incomplete. Many of the resulting products are highly offensive in character, but the solid portions have been largely liquefied, and otherwise altered so as to bring them into a condition which renders them readily oxidizable.

If, now, in the natural course of events or by artificial means, air is brought in contact with them, the volatile gases will be dissipated, and gradually the aerobic bacteria will take up the work and carry it on, as shown by the diagram, to the points where nitrification begins; which, with the final oxidation of the nitrogenous and carbonaceous residues of the previous processes, proceeds in much the same way as that already described in connection with aerobic decomposition.

The two processes outlined above, though beginning under opposite conditions, and proceeding in an entirely different manner, achieve in the end the same result, viz., the destruction of organic matter by its conversion into stable, gaseous and mineral substances. They are nature's methods, and have been in operation over the surface of the earth since the first appearance of life upon it.

Under conditions of abundant aeration they are without any disagreeable or other noticeable features. Where the air has no access, putrefaction takes place, and when complete and efficient drainage systems were first constructed, it was this tendency of the sewage to putrefy when discharged broadcast into relatively small streams which created the demand for its purification. Ignorance of the true nature of the processes involved led to many attempts to accomplish this by purely artificial means, but experience has shown that these efforts to supplant nature on such a large scale have always resulted in practical failure. Since that time the investigations of the biologists have shown the reasons why they have failed, and at the same time have led to the discovery and employment of methods which are proving successful, because, by providing the most favorable conditions and removing or holding in check those which operate adversely, they assist nature in every way; the result being that purification takes place at many times the rate possible when not thus controlled. To this extent only are such methods artificial.

* Vol. XLVI. p. 81, Dec., 1897 and Vol. XLVII. p. 685, Jan., 1907 (Cantor Lecture).

The ratepayers of Revelstoke have decided in favor of granting a $3,000 subsidy to the Revelstoke Navigation Company for the placing of a steamboat on the Columbia river which will afford transportation for the Big Bend district.

The Bay of Quinte's Steamboat Company's steamer "Hero" was burned at Belleville, Ont. The crew and several passengers, who were in bed at the time were all rescued. The steamer was valued at $25,000, and was insured for $20,000.

The Nanaimo, B.C., Shipbuilding Company has been formed with the following officers: President, Andrew Haslam; secretary-treasurer, Geo. L. Schetky; solicitor, E. M. Yarwood; directors, Dr. MacKechnie, Ald. J. H. Cocking, Edward Quennell. The capital is $250,000.

The new R. & O. steamer "Kingston," whose dimensions we gave last year, started on her route this month. On the first return trip the run was made from Kingston to Charlotte, 83 miles, in 5 hours, and from Charlotte to Toronto, 03 miles, in 5¼ hours. The company will build a marine railway at Sorel for repairing vessels. The work will cost $100,000. Negotiations are going on for the acquisition of the Niagara Navigation Co. by the R. & O. company.

AGENT—The United Asbestos Co. Ltd., of Dock House, Billiter Street, London, England, (the oldest Asbestos Mine Owners and Manufacturers in Europe) are prepared to appoint a first class firm as Sole Selling Agents for Canada. Terms and particulars on application.

WANTED By the Stratford Gas and Electric Light Company, Stratford Ont., a manager. Apply to the president on or before the 21st inst., stating experience and salary. A young married man preferred.

FOR SALE

Electric Lighting Plant

Modern Equipment, in good repair, in an Eastern Ontario Town. Street lighting contract and well established paying business, field for expansion. Splendid opportunity for young man. Reason for selling retirement of member of firm.

Address: LIGHTING PLANT

care of "Canadian Engineer."

The Canadian Engineer

VOL. VIII.—No. 18. TORONTO AND MONTREAL, OCTOBER, 1901. {PRICE 10 CENTS {$1.00 PER YEAR

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE
CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.
OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 1392. Montreal Telephone, Main 2589.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR. R. R. SAMUEL
TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month, or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

	PAGE
Accident Prevention Appliances	433
Automobile Savings Bank	xxiv.
Automobile Explosion	418
Calipers and Dividers	417
Canadian Association of Stationary Engineers	430
Casting Aluminum	xvii.
Cement, Points on	416
Cold Water Paint	417
Dominion Iron and Steel Co	433
Dr. Bang's Electric Lamp	434
Direct Connected Generating Set	415
Effect of Time and Temperature on the Strength of Steel and Iron	413
Electrical Mining Machinery	412
Electric Flashes	425
Electrolytic Amalgamation	xxv.
Engineers' Club of Toronto	432
Fires	430
Freights to the Yukon	434
Gas Engines, Progress of	411
Generating Set, Direct Connected	415
German High Speed Electric Railway	419
Huronic	412
Hungarian System of Telegraphy	xxiv
Industrial Notes	422
International Engineering Congress	410
Leather Belting	xxxiii
Literary Notes	431
McCormick Turbines in the Comstock Mines	414
Marine News	427
Mining Matters	428
Miscellaneous Notes	434
New Catalogues	433
New I.C.R. Ferry Steamer	432
New Incorporations	430
" "	iii.
" "	xxxiii.
Personal	429
Railway Matters	429
Street Car Fender Question	414
Syndicate Exhibit at the Pan-American	414
White Star Liner Celtic	432
Water Power Development at Chaudiere Falls	407
Water Tube Boilers	418
Yukon River Improvements	418

Advertisers will please note that this paper will hereafter be published on he 1st instead of the 10th of each month. Changes of copy should be in our hands correspoodiogly early.

WATER-POWER DEVELOPMENT AT CHAUDIERE FALLS, QUE.

This development is situated on the Chaudiere river, two miles from where it discharges into the St. Lawrence river at a point about five miles west of the city of Quebec. The Chaudiere river rises in Lake Megantic, close to the boundary line between the United States and Canada, and has a drainage area of about 2,500 square miles of hilly and rocky country, and owing to the character of the drainage basin of this river, the water runs away very quickly, and the variation between high and low water flow is very great. Repeated gaugings of the flow, however, indicate that about 600 cubic feet per second can be relied on all the year round at this development.

The "lay of the land" in the vicinity of this development was peculiarly well adapted for the purpose. In the main fall the river has a straight drop of 85 feet and from this point there is another 10 feet of fall in the distance of 1,000 feet to tail-race outlet. The natural head at this location was 95 feet, and this has been increased to 114 feet by building the dam across the head of the falls. Under this head the above amount of water would give 6,000 h.p. on shafts of turbines having an efficiency of 80 per cent. This amount can, of course, be considerably increased by a system of reservoirs that would hold a certain percentage of the water now wasted in periods of high water, allowing it to escape when required to increase the low water flow. On the left side of the river there is a gulley forming a channel through which water formerly flowed in flood season. This gulley forms an ideal location for the pipe lines and power-house, and the high, rocky island between this valley and the falls, protects them from all danger from high water, and also protects the power-house from spray during all seasons.

The geological formation of this region is very peculiar. The river bed is of red shale dipping up stream at an angle of 45 degrees. Layers of very hard stone, varying in thickness from a few inches to several feet, occur frequently in the shale, forming bars at about right angles to the course of the river. This hard stone was of excellent quality for building, and was used throughout the work in concrete and masonry.

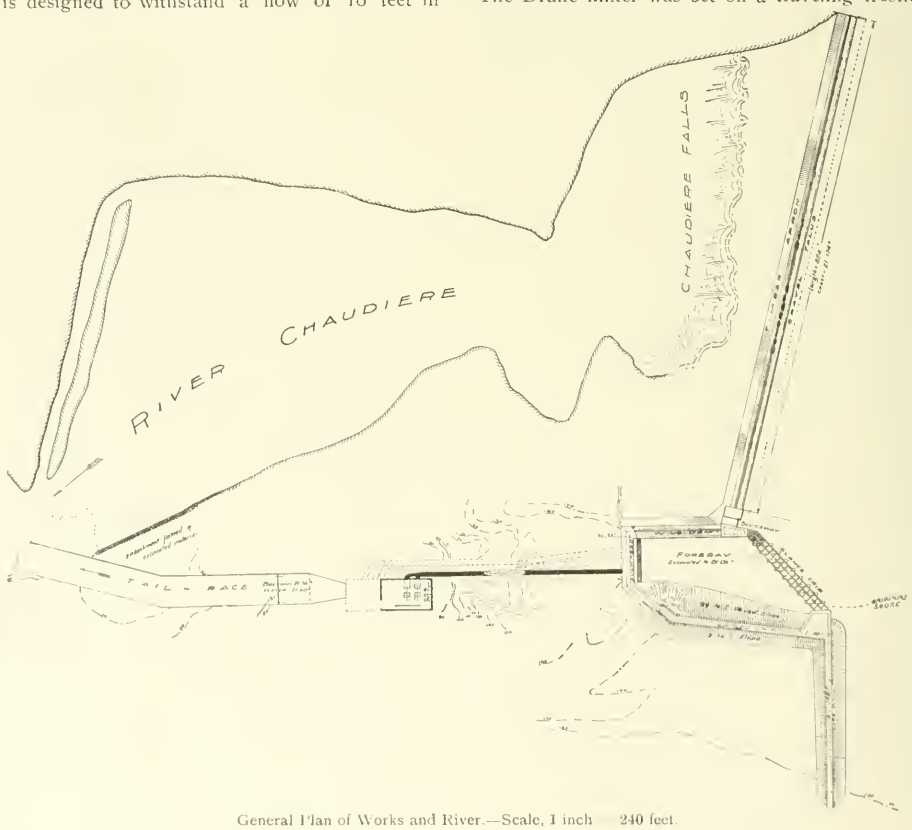
Surveys for the present development were made in December, 1898, and work was commenced in September, 1899, and continued through the winter of 1899 and all of 1900. The entire plant was put into operation on April 15th, 1901, supplying electric current to the town of Levis, about nine miles distant. Briefly stated, the general scheme of development is as follows: Immediately above the crest of the falls an ogee concrete dam, 18 to 22 feet high and 824 feet long, is carried across in a straight line from the east bank of the river to within 150 feet of the west bank, where this section terminates in a heavy angle pier and sluiceway. From this point the dam turns at about right angles and continues down stream about 150 feet, forming a wing dam. At this point, and founded on a ledge of solid, hard rock, a bulkhead, having the necessary openings for three large and one small penstocks, is carried towards the west shore of the river. An earthen embankment, with concrete core wall, runs from the west end of the bulkhead, parallel to the river, to a point some distance above the line of the main dam, and then turns and runs into the high ground on the west bank of the river. At the corner of the embankment the core wall is carried out so as to form an angle pier or abutment. From this pier, to the angle pier on the overflow, is carried a cribwork glance pier with submerged openings to admit water into fore-bay or head-race. This crib lies on an angle to the course of the river, and is supposed to deflect any floating debris, frazil or anchor ice over the main dam or through the sluiceway. Large steel penstocks carry the water down to the power-house, which is situated as close as possible to the base of the hill, so as to keep the penstocks short, and obviate trouble caused by water-hammer, and consequent difficulty in governing units supplied through long feeder pipes. The power house is built to accommodate four units of 1,000 h.p. each with necessary exciters. The tail-race is carried

down of ample width and depth to allow water to escape without backing up on the turbines.

MAIN DAM, SLUICEWAY AND WING DAM.

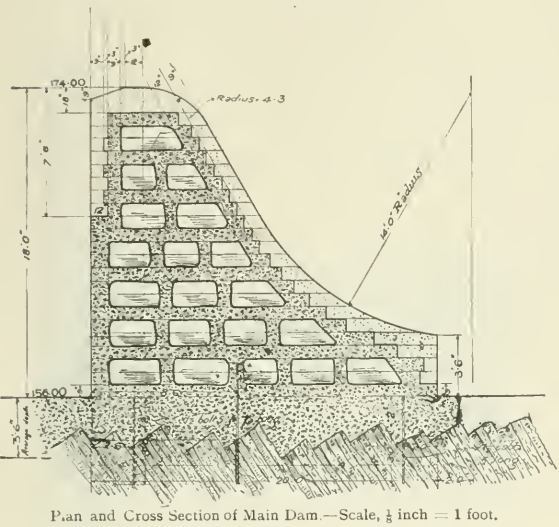
It was originally intended to build the dam of timber crib-work 25 feet high. At the time of commencing, however, suitable timber was extremely scarce. It was, therefore, decided to build the dam of the more permanent material, and an ogee dam, 18 feet high and 20 feet wide on the base, was designed for the work and built of 1-2-4 concrete with large stones embedded in the core. These stones were kept nine inches apart, vertically, twelve inches apart, horizontally, and twelve inches back from the face of the work. Mortar was laid up against the forms to form a good surface on the work. The dam is quite heavy in section, as will be seen on accompanying plan, and it is designed to withstand a flow of 10 feet in depth of water over the crest. All cement used was tested on the ground under a very rigid specification, before it was allowed to go into the work, and numerous 9 inch by 9 inch cubes were made from batches of concrete going into the work, taken at regular intervals every 50 feet in length of dam, and tested at McGill University, Montreal, to determine the crushing strength. The results of these latter tests were very gratifying, many of the cubes when only twenty-eight days old, standing 2,600 lbs. per square inch without failing. The rock under the dam was mostly of a shaley nature. The top of this was carefully removed and cleaned off, so as to form a rough bed on the underlying material where it was perfectly solid. Owing to the 45 degree dip of the rock, this resulted in forming a toothed bed which obviates any danger of sliding.

Before any concrete was laid the bottom was washed with a hose and swept perfectly clean. All interstices were then grouted full and a 2-inch layer of 1 to 2 cement mortar laid all over the bed. Anchor bolts of 1½-inch round iron, upset to 3-inch at both ends, and from 5 to 8 feet long, were then set and cemented in holes drilled about 3 feet in the rock so as to bond into the concrete, at frequent intervals, and give the dam still greater stability. The concrete was then brought up level with the original bed of the river and at this elevation the forms were commenced. The stone used was all machine broken and most of the concrete was mixed by mechanical mixers, both the Drake and the Cockburn-Barrow mixers being used. The Drake mixer was set on a traveling trestle straddling the dam, the product thus discharging directly into the work. This trestle was supplied with cement, sand and stone for making the concrete, and large stones which were built into the work by means of a traveling derrick running along the north side of the dam. The Cockburn Barrow mixer was used on a stationary platform, which was located at various points as required, for building abutments, etc. On the crest of the dam is provided 4-inch by 6-inch holes at 6 feet centres, into which uprights for holding flash boards can be placed. These holes are all drained by 2-inch pipes running out through the down stream face of the dam. A timber apron, 12 feet wide at the narrowest point, built of 12-inch by 12-inch rough timber, sheeted



General Plan of Works and River.—Scale, 1 inch = 240 feet.

with two layers of 3-inch plank, and solidly packed with stone, is carried along the toe of the dam. This apron is laid on a slope which is tangent to the lower curve of the face of dam and is carried out to such a distance that the drop from the end of the apron to the rock is in no case over three feet. For the greater part of its length, the drop is less than two feet. All



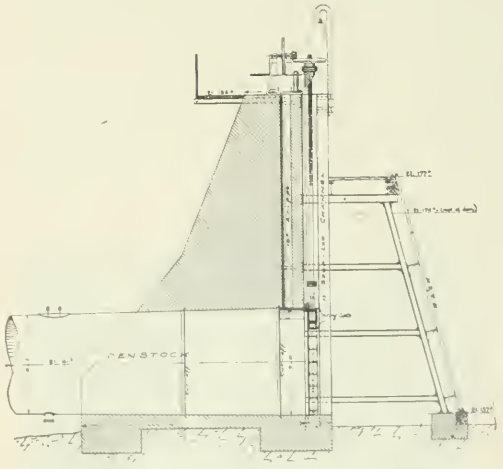
Plan and Cross Section of Main Dam.—Scale, $\frac{1}{8}$ inch = 1 foot.

the stringers in this apron are solidly bolted to the rock bottom with 1½-inch fox-bolts, running 5 feet into same. A heavy talus of gravel, 9 feet high, is carried along the upstream face of the dam, and running back on a slope of 1½ to 1. This will tend to prevent leaks through the rock under the dam. The east abutment is a heavy concrete structure, with long wings carried well back into the clay bank. The back of this abutment is drained by an 8-inch tile pipe discharging near the toe of the dam and as the bank on this side of the river is full of springs there is generally quite a flow through this drain. At the west end of the main overflow dam is a sluiceway 12 feet in width, the flow through which is controlled by stop logs sliding in channel iron grooves. The pier between the main dam and the sluiceway is 15 feet thick, and the other side of the sluiceway is formed by a heavy angle pier which is built up in solid concrete for a part of the way, and for the rest of its height has concrete walls. The interior is filled with packed stone and concrete over the top. Two pipes drain out any moisture that may accumulate in the core of the pier. This pier also forms an abutment for the end of the glance pier, and for the wing dam overflow along the east side of the fore-bay from the bulkhead to it, which is 144 feet long of precisely the same as the main overflow.

BULKHEAD.

The bulkhead is built of concrete with large stone embedded in it. It is 20 feet wide at the base, and 6 feet wide on top, and is about 28 feet high, the top of it being 10 feet higher than the crest of the main dam. Twenty feet of this bulkhead is at right angles to the main portion, and in line with the wing dam, and forms an abutment for the latter. In this section is set a sluice valve 30-inches in diameter, with conical steel plate discharge pipe, tapering from 30 to 24 inches diameter, placed one foot below average bottom of fore-bay, so as to drain out sand and water when required. The main section of the bulkhead is 85 feet long. Running through this section are three inlet cones for main penstocks, 9 feet in diameter, at the upstream end and 8 feet 3 inches in diameter where they project on the downstream side of the bulkhead. There is also one small penstock for the exciter units, 3 feet in diameter at large end, and 2 feet 6 inches in diameter at small end. These cones begin two feet back from the face of bulkhead. This space of two feet is arched over and from the top of the arches to the top of the bulkhead are carried up four air pipes for each large cone and two pipes for the small cone. These pipes are of wrought iron 10 inches in diameter, and they admit air to penstocks when the gates are closed, and also allow the air to escape from the penstock when filling same. Without these pipes a vacuum might be formed when the water was drawn off rapidly, and this might give the penstock a tendency to collapse through atmospheric pressure.

The cones are built of boiler plate 5-16-inch thick and are each provided with two 3-inch by 5-inch angle iron cut-offs, riveted around the cones. These are to make joints with the concrete and to prevent leakage along the cones. On the top near the downstream end of the cones are placed 15-inch by 24-inch manholes with cover and bolts to allow of admission for examination of gates or penstock. A 6-inch drain pipe closed by a blank flange is placed on the under side of the cone just outside the bulkhead through which any leakage water from gates can be drained when head gates are closed and thus prevent it going down the penstock



Cross Section of Bulkhead.

when any repairs are necessary to turbines below. The entrances to inlet cones are closed by steel head-gates, sliding in a steel framework built into the face of the bulkhead. The head-gates are of special design, and are built of 8-inch steel I-beams spaced about 12 inches apart, and these are riveted to 3-8-inch plate covering the whole area of gate with additional planed bearing strips of 4-inch by 5/8-inch steel riveted on this plate where the gate bears on planed T bars, which are built

into the bulkhead. The gates are constructed in two portions with heavy bolts passing through same, the upper portion, about 27 inches deep, is secured to the lifting stem by means of a coupling, being so arranged that it can be raised about 12 inches high before the nuts on the rods secured to lower portion engage the upper part. Through the space thus formed the water can enter the penstock until the same is full and the pressure on both sides of gate thus equalized, the whole of the gate can then be readily raised the full height by the "single purchase" of the winch.

Concrete Dam in Course of Construction.

The hoisting mechanism is also of special design, and is operated by hand. It consists of a steel stem 4 inches in diameter, with double screw of square tread of 1¼-inch pitch, and a bronze nut for same, mounted between two rows of ¾-inch hardened steel balls with hardened steel plates forming a runaway for same. This nut is keyed in the centre of a large mitre gear wheel, which engages with a suitable pinion on a 2-inch shaft, in rigid bearings, with the end of same squared for a crank handle—this is called the "single purchase." These parts are carried on suitable heavy cast-iron stands, the front one projecting out over the head-gate space about 15 inches. On the shaft of the "single purchase" is placed a 90-toothed spur gear which gears into a 15-toothed pinion on a second shaft which is also arranged with a squared end for a crank

General View of Work in Construction.

handle—this pinion is on a feather and can be shoved in and out of gear by sliding it on the shaft. This double purchase is only required in a case where it might be necessary to force the head gate closed against the pressure of the full head of water, such as might occur if the gates of the turbines should happen at any time to get blocked so that they could not be closed to stop the flow of water through the penstock. These winches can handle the gates with great ease under ordinary conditions with the single purchase.

Stop-log checks, composed of 12-inch steel channels are provided into which stop-logs can be dropped in case of emergency. Overhanging and fastened to these channels is a framework and track composed of 3-inch by 5-inch angles, on which a traveling chain block, to pull up stop-logs when necessary, runs from end to end of the bulkhead. The entrance to penstocks is protected from rubbish and drift wood, carried in the water, by a fine rack built of 3-inch by ¼-inch bars, spaced at 1½-inch centres, with bolts and separators, and supported on a heavy steel I-beam

View of Complete Dam during Spring Freshet.

framing laid on a batter of about 3-inch per foot. This rack is made in sections, about 4 feet wide each, and is carried on special castings made so that any section can be taken out for repairs if required. Owing to the comparatively small size of the buckets of turbines and the high speed at which they run, it is especially important that all floating substances should be kept out of the penstocks. The west end of the bulkhead is carried around to meet the concrete core wall of the earthen embankment.

(To be continued.)

INTERNATIONAL ENGINEERING CONGRESS.

One of the most noteworthy conventions of the year 1901 is the International Congress of Engineers, which assembled at Glasgow during the past month. It was organized by the Institution of Engineers and Shipbuilders for Scotland, in co-operation with the technical institutions in London, and drew together over three thousand delegates, many of them distinguished in the world of science. It was the most ambitious affair of the kind ever arranged in Britain, and for engineers is expected to prove the most useful and important congress ever held. There were no less than nine sections, covering iron and steel, mining, engineering, naval architecture, mechanical engineering, municipal and gas engineering, waterways and maritime works, railways and electrical engineering. Lord Kelvin, one of the world's most distinguished scientists, delivered the inaugural address. Mr. Mansergh, who was brought out to this country to report on Toronto's water supply, now president of the Institution of Civil Engineers, presided. Among the most popular papers were the following: "The Economy of Electricity as a

Motive Power on Railways at Present Driven by Steam," by Professor C. A. Carus Wilson; "Novel Plant Used in Excavations and Transport on the Chicago Drainage Canal Works," by J. Randolph, U.S.A.; "The Improvement of the Lower Mississippi, by the River Commission," by J. A. Ockerson, U.S.A.; "Canadian Agricultural Machinery at Glasgow Exhibition," by G. H. Frost; "A Premium System of Remunerating Labor," by James Rowan; "Pneumatic Tools," by J. C. Taite; "Naval Development in the Nineteenth Century," by Sir N. Barnaby; "The Correct Treatment of Steel," by C. H. Ridsdale; "The Manufacture of Coke as Carried Out by the Oliver and Syder Steel Company's Plant, Pennsylvania, U.S.A.," by F. C. Keighley; "Electricity and Road Vehicles," by A. R. Sennett; "The Mineral Resources of Quebec," by J. Obalski.

One of the most interesting subjects which came up for consideration, was the proposed tunnel between Scotland and Ireland. The route recommended by the committee appointed for that purpose is from a projecting point in Wigtonshire to the county of Antrim or Down, and would be from 20 to 25 miles long. The estimated cost is £10,000,000.

An interesting function in connection with the congress was the inauguration of a new engineering laboratory at Glasgow University, in commemoration of James Watt. It has been equipped at a cost of about £50,000, and is one of the most complete in the United Kingdom. Unlike some of the laboratories in other institutions, the equipment does not include anything for the training of the students in mere handicraft, which is easily acquired in ordinary workshop practice. The idea rather is to educate the student to the close observation and application of scientific principles to the testing of that which handicraft produces. This is a very important distinction which is not always realized even by educational authorities.

Of course there were social functions and excursions almost without number, and the visits to the laboratories and workshops with which Glasgow, which may be called the cradle of engineering, abounds, could not fail to be both interesting and instructive.

PROGRESS OF GAS ENGINES.

The United States consuls recently made a special report to Washington on the extent to which gas engines have come into use in various countries in recent years, and The Gas Engine has been allowed to publish extracts from the advance sheets of these reports. A number of these reports which were made in 1900 are from Canada, but the extracts do not give the results in large centres like Montreal, Toronto, Quebec, Hamilton, etc. Such reports as are given are summarized below:

The consul for British Columbia says: There are only 5 gas engines on Vancouver Island. Of these, only 1 is in practical operation, that used in the office of the British Columbia Printing and Engraving Company. The others have not been in use for some time. It is possible that if particular attention were given to the trade, gas engines might be more generally used in the cities of Victoria and Nanaimo, both of which have good gas plants and other industries, though there is comparatively little manufacturing done on the island, and consequently only a minimum need of motive power.

The consul at Winnipeg states that gas engines are extensively used in Manitoba, and the demand is growing from year to year. They are imported almost entirely from the United States, principally from Beloit, Racine, Chicago and St. Paul. A small number of engines are brought into this district that are manufactured in Ontario, and a few are made in Winnipeg, but Canadian-made machines are more expensive than the American, and, being of inferior quality, do not come into serious competition with them. From 400 to 500 American-made engines have been sold in the district by Winnipeg dealers, principally for use in grain elevators along the numerous railroad lines running out of this city. They range in size from 4 to 16-h.p., and in price, according to size, from $250 to $1,500 at retail. Quite a number of engines of 1 and 2-h.p. are in use in small creameries throughout the district; these are principally Ontario-made, and retail at from $75 to $175. An attempt was made this year to introduce gas engines for running threshing machines. Two car-loads of 12 to 16-h.p. portable engines were imported from the United States for this purpose, and in the early part of the season, many orders were taken for them at prices ranging from $1,150 to $1,400, but the failure of the wheat crop compelled the cancellation of most of the orders, and few sales were actually made. The prospect is that, owing to the economy in fuel, water and labor, resulting from the use of gas engines, they will come into almost universal use for threshing purposes, as well as in all other industries where light power is required. One gasoline fire engine was bought by the municipal government of Winnipeg as an experiment a year ago, and has proved satisfactory. Others will be purchased as the needs of the city may require.

The commercial agent at Moncton writes: Two engines purchased in Toronto have just been set in operation here. I am told that they give perfect satisfaction, and from present prospects there will be considerable demand for such machines. The prices of engines of Canadian manufacture range from $170 for one and one-half horse-power to $320 for seven horse-power; larger and intermediate sizes in proportion. A few engines are imported from England and from the United States. I have been informed that the prices are somewhat higher than the Canadian.

The consul at St. John reports: There are but two important cities in this district—St. John (50,000), and Fredericton (8,000). There are only two gas engines in use in this city (St. John), one English and the other American. Electric plants are in both cities, and hence electric motors are preferred and more generally used, the cost being about the same. In the country districts, where they have no electric plants, gasoline or naphtha engines are in general use. The prevailing prices for gas engines are about 10 to 15 per cent. lower than the American prices. The source of supply is mostly from Montreal, Toronto and Galt. My opinion is, if American manufacturers can compete in prices with Canadian manufacturers, there is a probability of profitable business being done.

From Sydney the consul writes: Gas engines are not used in this portion of Nova Scotia at all. Close enquiry among the users of engines in this community has failed to show where one is used either for stationary or marine purposes. The cost of bituminous coal has been so low in Nova Scotia heretofore that no attention has been given to the use of motive power, the fuel for which was not furnished by coal. Now that the demand for coal has forced prices to the point they have reached here, the mines with their present production being unable to supply the demand, other motive power could profitably seek an introduction into this market.

From Ontario the London consul writes: Gas engines are not extensively used in this part of Ontario. I find a few of the smaller patterns here in London, but I think the utility of gas as a motive power in the ordinary factory or establishment has not been fully understood heretofore, though it is gradually coming into favor. There are several factories in this province, but as to the comparative worth of their engines, I am not informed. I found one English-made engine here and a few Canadian and American engines. I have talked with a number of factory men who are anxious to employ the gas engine in connection with their establishments, and I see no reason why our engines should not be profitably handled in this market, especially if they show superior merit. I think

they should be handled by United States agents or representatives. In all cases, where possible, a display should be made of the foreign article intended for introduction, especially where any particular points of excellence exist. It should be borne in mind by our manufacturers that while they have a protective duty to overcome in reaching this market, the Canadian manufacturer has a serious problem to solve in the price of fuel.

The Niagara Falls consul reports: Owing to the high cost of both oil and gasoline in Canada and the cheap water power and electric power in this district, the opening for gasoline engines in this vicinity is a limited one. I only find four gas engines in use, although this is a busy manufacturing district. These are from 4 to 5-h.p., and range in price from $300 to $400 each. Two of them were purchased in Montreal and two in Buffalo.

The Charlottetown consul writes: I am unable to find but three gas engines in use in this city—two by publishing houses and one by the city waterworks at the pumping station. I am confident, however, that others could be introduced and sold, as there are many branches of trade that could use them to advantage.

The Quebec consul says: There are several gas engines in use in this city—all of American manufacture. Those using gas engines say the power is cheaper than electricity. One party, who is well posted on this subject, thought that gas engines could be more generally introduced with practical efforts—by means of instructions in regard to setting up the engines, lighting them, etc. The manufacturers should have agents in Quebec.

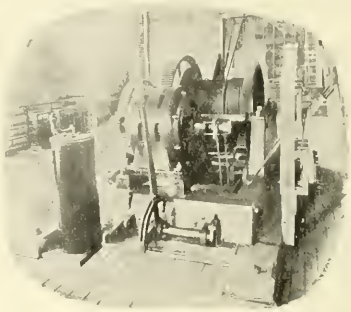
The consular district of Stanbridge, embracing the counties of Missisquoi, Brome and part of Iberville, is an agricultural country, by reason of which the principal enterprises would naturally be creameries and cheese factories. The consul reports that the power generally used in these is either water or steam. The patrons of these factories are altogether farmers, who not only supply these factories with milk and cream, but also with wood for fuel. To substitute gas engines for the engines now employed would cause a serious loss to the farmers (i.e., in the matter of fuel supply), and it would be natural that they should not want something new which would diminish their incomes. In the town of Bedford, 3 miles distant, the manufacturers of gas engines may be able to introduce their product, for the reason that the water supply at this town can not always be relied upon, and very often manufacturers have been obliged to use steam. He concludes: I would suggest that manufacturers of gas engines exhibit their machines at the different fairs which take place in each county in the Province of Quebec during the month of September."

The consul at Dawson says: Gas engines are not used in the Yukon consular district, nor are they likely to be for some time to come. Wood is the principal fuel for steam boilers, although coal is coming into use. Cord wood, in logs, is worth $20 per cord; coal, $25 per ton, and coal oil, $1.25 per gallon. There are ample facilities for the transportation of machinery by rail and steamer from the United States to Dawson, freight being about $125 per ton from the Pacific coast.

Reports are given from South and Central America and from Europe, Asia, Africa and Australia. Some, of course, are discouraging, others very encouraging to the manufacturers of gas engines, according to varying circumstances, such as the occupations of the people, the cost of fuel, etc. We would advise Canadian gas engine manufacturers to get a copy of this report when issued in book form, as they will get some serviceable hints from it.

ELECTRICAL MINING MACHINERY.

Of the many difficult propositions offered the electrical manufacturer, perhaps none has seemed more simple nor developed more difficulties than that of operating mining machinery by the use of alternating current motors. One of the successful solutions is shown in the cut below, showing a 30-h.p. threephase induction motor operating at 900-r.p.m. on a 220-volt 60-cycle current supplied by the West Kootenay Power & Light Company from their power house at Bonnington Falls. The motor was installed for the California Mining Company, Rossland, and is geared to the hoist. Rawhide pinion and double reduction gears are used, giving the cable a speed of about 500 feet per minute. The motor and equipment was made by the Canadian General Electric Company at their Peterborough factory, and supplied through their branch office in Rossland. It is one of their Form M having external armature resistance which may be cut in or out by means of the controller, thus allowing the hoist to be



operated at various speeds. Many similar equipments have been installed in this camp, and have proved very satisfactory, wherever the hoisting engine has been properly designed for use with an electric motor. There is also an induction motor direct connected to a centrifugal pump, the whole especially designed by the Canadian General Electric Company for mining use.

THE HURONIC.

The large steel steamer Huronic, built by the Collingwood Ship Building Co., to the order of the Northwest Transportation Co., Ltd., was launched Sept. 12. She is built of open-hearth steel, and is of the following dimensions: 325 feet over all, 308 feet between perpendiculars, 43 beam by 27 moulded depth. She is the largest steel steamer ever built at a Canadian shipyard. The new vessel will have cabin accommodation, fitted up in first class style, for fully 250 cabin passengers, and will have considerable accommodation for the carrying of steerage passengers. The lower cargo hold is divided into five compartments of a combined capacity for 80,000 bushels of wheat; in addition to this there is a storage capacity on the main deck for 700 tons of package freight, making a maximum load on eighteen feet of 3,100 tons, with 300 tons additional allowed for fuel. She is divided by six water bulkheads into seven water tight compartments, extending from the keel to the main deck, which should make her a very safe ship. She has a water ballast capacity in her water bottom of about 800 tons, divided into eight different compartments, and is well lighted throughout from a duplicate electric lighting plant, fully 500 lights being provided throughout the entire ship. The propelling machinery was built by John Inglis & Sons, Toronto. She was launched

sideways into the Collingwood drydock, the width of which is little more than the steamer's beam, but the feat was successfully accomplished.

Hon. J. I. Tarte was present. He referred to the transportation question, and said, in the presence of Mr. Reeve, general manager of the Grand Trunk, that he hoped the time would come when the managers of that road would come back to the St. Lawrence route, because it is the shortest to the English market. In two years vessels of 10,000 tons would be able to use the St. Lawrence route. He almost promised that the Government would bonus shipbuilding in Canada to encourage the building of Canadian bottoms to carry Canadian trade in Canadian channels. He said a Canadian lake marine would make us a nation quicker than most people believed. He stated that he had recently rejected the proposal of the Wolvin syndicate to build elevators and ship grain from Montreal, because they had said they would not build their vessels in Canada.

Immediately after the launch the keel of another steel vessel, for the Clergue syndicate, was laid.

THE EFFECT OF TIME AND TEMPERATURE ON THE STRENGTH OF STEEL AND IRON.

Ernest Geo. Coker, M.A., assistant professor of Civil Engineering, McGill University, Montreal, has been making some experiments on the above subject. Some extracts from his paper read before the Canadian Society of Civil Engineers, will be of interest.

The behavior of iron and steel under simple stresses of various kinds has long been a subject of investigation by the engineer, and very complete data are available for use in designing structures in metal. When iron or steel is subjected to tensional stress sufficient to cause a permanent stretch in the material, it is well known that the ductility of the material is reduced, and that ultimately the elastic limit rises. As a first consequence, however, the elastic limit is first of all lowered, in some cases to zero, but if the bar be left to itself the elastic limit ultimately rises to a higher value than before. In the last few years the phenomenon has received considerable attention at the hands of Bauschinger, Ewing and Muir. The present paper relates to a few experiments which have been made in the Testing Laboratory, McGill University, following the lines indicated by the authorities mentioned above.

The measurement of the change in length of a bar, by such a small quantity as 1/50,000 inches has been rendered comparatively easy by aid of extensometers devised by Bauschinger, Unwin and Ewing. The instrument mainly used in these experiments was one constructed after Prof. Ewing's design, and has several novel features. It is, moreover, especially adapted for work where several settings of the instrument are necessary.

When a bar of iron or steel is subjected to a tensional stress sufficient to cause a permanent stretch in the material, the physical character of the bar changes, and it becomes semi-plastic, while its elastic limit generally reduces to zero, followed by recovery, which is comparatively rapid in the case of wrought iron, but less so in the case of steel. As an example of this, the case of a mild steel bar may be taken. This bar, and others referred to later, were cut from a piece of boiler plate, and afterwards straightened and annealed. The bars were machined to a breadth of 2.07 inches, and the thickness was left untouched, the mean thickness in the present case being 0.377 inches, and the length under test 8 inches. A test was first made to give the bar a permanent stretch, and the measuring instrument was immediately re-set to the standard distance of 8 inches, and a re-test was made, rising by increments of 2,000 pounds to 24,000 pounds, and then to zero again by decrements of 2,000 pounds.

A comparison of the readings obtained at once shows how differently the bar behaves after the tensile overstrain. There is now no linear relation between the stress and the strain, but the latter rises irregularly as the stress increases; the differences are irregular and do not agree except accidentally with the differences obtained as the load is removed. The bar was now laid on one side, and a gradual recovery of its elastic properties took place, which was shown by the approach to the first readings made. At the end of three hours there was a marked recovery. The tests of the bar were repeated at the end of one day, 3 days, 7 days and 28 days, and these showed a further recovery, whose rate diminished with the time, but at the end of the month the recovery was practically complete.

The recovery of iron and steel from sheer strain appears to follow the same general law as for tension. It will be sufficient to quote the case of a turned specimen of wrought iron, having a diameter of .0146 inch, and length under test of 4.00 inches. The specimen was subjected to shear by a twisting couple, and the distortion between the sections was measured by a strain measuring instrument of special design. The bar was first subjected to torque of gradually increasing amount until the elastic limit was passed. Immediately after the load was released and a new series of readings obtained, the maximum torque applied being 375 inch pounds, and similar observations were recorded at the end of one hour, 3 hours, 1 day, 4 days and 8 days, the last experiment showing practically complete recovery.

It is well known that if a bar of iron or steel be stressed beyond the elastic limit in tension, it will regain its elastic properties if raised to a dull red heat and allowed to cool slowly in air or in lime, and this process may be repeated again and again without seriously affecting the physical properties of the bar. Recently our knowledge of annealing has been greatly increased by the discovery of Muir, acting on a suggestion of Prof. Ewing, that a comparatively low temperature, such as that of boiling water will restore a strained bar to its elastic condition. As an example of this a test made in the McGill laboratory shows the effect of boiling water upon an overstrained bar. The specimen was a flat bar of boiler plate, width 2.07 inches, thickness 0.375 inch, and length under test 8.00 inches. This specimen was similar to the one used in the first experiment, and was annealed at the same time. The first notable deviation from perfect elasticity began when a total stress of 20,000 was applied, and at 25,000 the extension amounted to 8.13 inches, an increase of stress to 27,000 pounds caused a further extension to 8.15 inches. The load was then removed, and the bar was exposed for 10 minutes to the temperature of boiling water and again re-tested. It indicated a yield point at about 31,000 pounds, considerably above the first. The boiling was repeated in the same manner, and a new yield point was obtained at 36,500 pounds, while further tests after annealing in boiling water gave new yield points at 41,500, 45,600 and finally 48,100, when the bar broke, with a total extension of about 15 per cent. This extension is less by about 6 per cent. than would have been obtained if the bar had been stressed to breaking without any intermediate treatment. Even a temperature of 50 degrees C. effects a considerable physical change in a bar of overstrained material, restoring its elasticity and raising the yield point.

The annealing effect of boiling water is equally marked upon material overstrained by shear. As an example, a test was made upon a turned steel bar of 0.425 inch diameter, and having a length of 4 inches under test. On each occasion the stress was carried well beyond the yield point, and was followed by immersion in boiling water for 10 minutes. After each stress and subsequent heating, the recovery was practically complete, and the yield point rose after each annealing. At the end of 9 separate twists the bar exhibited no change externally. A test of a steel bar was also carried out for me by Blanchard, Clement and Gagnon, fourth year students in the Civil Engineering Department. A turned steel bar of similar quality to the previous one was chosen, having a diameter of 0.757 inch, and a length under test of 8.00 inches. The strain measuring instrument was a simple graduated circle divided to 15 minutes, and readings could be estimated to 1 minute of arc. Each separate application of twisting moment was carried beyond the yield point, and was followed by immersion in water at 50 degrees C. for 15 minutes. Even this low temperature was sufficient to cause a very effective recovery to the elastic condition, the recovery being in all cases accompanied by a rise in the yield point. The remarkable effect of a slight increase in temperature in restoring an overstrained bar to approximately its primitive condition may ultimately prove to be of considerable practical importance, as it

affords a means of annealing, which, although not as perfect as that accomplished by the blacksmith, has the advantage that polished surfaces of iron and steel retain their polish and are not distorted by the process. In bridge structures and the like, exposed to repeated stresses and corresponding fatigue of the metal, the suggestion that this fatigue may be partially counterbalanced by the heat of a summer's day may not be so improbable as it at first sight seems to be.

It is interesting to determine what action low temperature, such as that afforded by a Canadian winter, has upon the behavior of steel after overstrain, and in order to contrast this with recovery at the temperature of the laboratory, viz., about 68 degrees Fahr., a specimen was taken similar to the one above described. The bar was 2.07 inches in breadth, and had a mean thickness of 0.378 inch, the length under test being as before, 8 inches. The specimen was first permanently stretched in exactly the same manner as in the previous case, and then exposed to the outside temperature for three days, during which the temperature varied from a minimum of —2.5 degrees Fahr, to a maximum of 11.2 degrees Fahr., and it was then subjected to a cycle of stress ranging from zero to 24,000 pounds. The bar was again exposed to the outside temperature, which had a mean value during the next four days of 18.52 degrees Fahr., a minimum value of —2.5 Fahr., and a maximum value of 31.72 degrees Fahr. A second test, on December 18th, showed very little change in the condition of the bar, and the bar was therefore given a long rest through the remainder of December and the whole of January. The mean temperature for the remaining days of December was 25.64 degrees Fahr., the highest 39 degrees Fahr., and lowest 0.6 degree Fahr. During January the mean temperature was 12.75 degrees Fahr., the lowest temperature recorded being —16.7 degrees Fahr., and the highest 39.6 degrees Fahr. The bar was tested again on February 1st, and exhibited some slight indications of recovery, but very small in comparison with the recovery which would have been effected by the ordinary indoor temperature. A final test was made on Feb. 26th, the mean temperature during the interval being 12.46 degrees Fahr., with a minimum of —4.0 degrees Fahr., and a maximum of 28.4 degrees Fahr. The recovery during this period was practically nil. It appears, therefore, that low temperatures tend to retard the recovery of steel which has been subjected to overstrain in quite a marked degree.

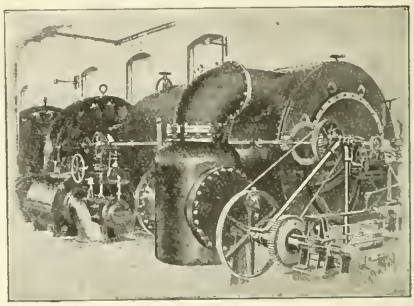
THE STREET CAR FENDER QUESTION.

The question of street car fenders has for some time been a vexed one in the Province of Ontario. The companies manifested great apathy in equipping their cars with a suitable life-saving device, and legislative action became necessary to compel them to move in the matter. In 1900 an act was passed providing for the adoption of a fender approved by the engineer of the Public Works Department. The engineer gave his approval to what is known as the Providence fender. There was no provision, however, for a penalty in case of neglect to apply the fender to the cars, and the companies did not adopt it, giving as a reason that they did not want to be held up by one fender company. The act was amended last session by providing that the provincial engineer might from time to time give his approval to any fenders which he considered suitable, and also providing a penalty for failure on the part of the companies to equip their cars. An order-in council has just been passed authorizing and approving of three styles of fender for use on street cars in Ontario, the Providence, the Twentieth Century and the Improved Sleeman. In the report on which the order in-council is based the engineer says: "I have examined all the drawings, models and full-size designs of street car fenders submitted to me, and, where possible, I have submitted such designs to practical tests. These examinations and tests have demonstrated to my satisfaction the superiority of the Providence, Twentieth Century and Improved Sleeman fenders over any other fenders I have seen and their suitability for use by electric railway companies, having regard to efficiency for life-saving purposes and the other considerations mentioned in the said act. I therefore beg to recommend the adoption of one or more of these fenders by the street railway companies of the province."

It will now be necessary for all street railway companies to adopt one or other of these fenders within the time specified by the order-in-council, namely three months, or render themselves liable to the penalties provided by the act for non-compliance, namely $10 per day.

M'CORMICK TURBINES IN THE COMSTOCK MINES.

This illustration represents a pair of 27-inch McCormick turbines, mounted in an iron case on horizontal shaft direct connected to a generator. They develop 1,400-h.p. with 400 revolutions when operating under 84 feet head. The extra pressure upon the wheel case and supply pipes caused by the heavy changes of load is taken care of by a Ludlow relief valve working in connection with a Lombard water-wheel governor. Two 15-inch McCormick turbines in iron cases on horizontal shafts are direct connected to the exciters. Two of these set-



tings complete were built by the S. Morgan-Smith Co., of York, Pa., for the Truckee River General Electric Co., Floriston, Cal. The power is transmitted 35 miles to the celebrated Comstock mines and is used for pumping water and operating mining machinery. The S. Morgan-Smith Co. also lately supplied the Floriston Pulp and Paper Co., Floriston Cal., with horizontal shaft McCormick turbines operating under 50 feet head, developing 4,700-h.p., which are used for driving machinery in its pulp and paper mill. The S. Morgan-Smith Co., of York, Pa., are makers of the McCormick turbine.

A SYNDICATE EXHIBIT AT THE PAN AMERICAN.

R. L. Crane, of the Prentiss Tool & Supply Co., 115 Liberty street, New York, sends this account of that firm's exhibit at the Pan-American: The exhibit we have here in Machinery Hall comprises about 2,000 square feet, and is one of the most complete ever attempted in any Exposition, not excepting Chicago and Paris. Our object was to represent an ideal machine shop and introduce machine tools that are the specialization of each concern represented. We have associated with us in this display, the following: The Cincinnati Milling Machine Co., the Cataract Tool and Optical Co., the Acme Machine Screw Co., Fay & Scott, the Lodge & Shipley Machine Tool Co., Cincinnati Planer Co., Rogers & Hemphill Machine Co., Cincinnati Machine Tool Co., Bickford Drill & Tool Co., the B. F. Barnes Company, George Jeungst & Sons Co.

The Cincinnati Milling Machine Co., making a specialty of plain and universal milling machines and universal cutter and tool grinders, are showing a No. 1, No. 3 and No. 4 plain miller, with improvements, not heretofore placed before the public; also a No. 2 full universal, all feed machine, and complete universal cutter and tool grinder. They also show a bench of attachments, mounted on sections of milling machine column, which is novel, and has attracted much attention. In testimony of the high character of these machines, the British Westinghouse Company have just purchased sixty in one lot for their new plant.

The Cataract Tool and Optical Co. have four of their precision bench lathes beautifully mounted in glass cases and one illustrates their lumbo head, which admits stock through spindle up to 1 inch diameter. These lathes are equipped

with their various attachments, milling, chasing, screw cutting, turret grinding, etc.

The Acme Machine Screw Company show one of their No. 1 multiple spindle automatic screw machines, 7-16 capacity, and a No. 3 with 7/8 capacity, in full operation. These machines are entirely new, and have about three times the capacity of a single spindle automatic, and, in some instances five times.

Fay & Scott are displaying a universal lathe, with turret on carriage and bed, the latter being provided with power feed. This lathe is having a very large sale, on account of its productive capacity over the ordinary engine lathe, in duplicate work, which shows an increase of about three times. It has the features of an engine lathe, with the independent rod and screw feed, power cross feed, and large hollow spindle, as well as automatic stop and, in addition, is provided with friction head and compound gearing, with a quick reverse motion, in the apron.

The Lodge & Shipley Machine Tool Co. have on exhibition 36-inch triple-geared lathes, a 24-inch and an 18-inch, with taper turning attachment. These are the lathes that have recently been purchased by the British Westinghouse Company, the order amounting to nearly one hundred in assorted sizes.

The Cincinnati Planer Co. show one of their new improved heavy pattern 30-inch wide by 30-inch high by 8-ft. bed planers, with two heads on cross rail and power elevating device. This planer embodies in its construction, the most approved ideas in planer practice.

The Rogers & Hemphill Machine Co. are introducing their new vertical boring and turning mill, of which we are the sole selling agents. They show a 31-inch heavy pattern single standard, swivel head, turret mill, with universal chuck and a 45-inch heavy pattern double head, double column with plain table and screw cutting attachment. These mills have embodied in their construction many new features.

The Cincinnati Machine Tool Co. show a 21-inch stationary head drill, plain, the same size complete with geared tapping attachment on spindle, as well as a 24-inch sliding head and two larger sizes, 28-inch and 32-inch swing. The geared tapping attachment on the spindle is entirely new and obviates the necessity of using a tapping device in spindle or friction countershaft. It is, of course, more efficient and adds to the time saving features, as it is always in easy reach of the operator and ready for business.

The Bickford Drill & Tool Co. show an entirely new radial drill, which is being introduced for the first time at this exhibit, in a No. 1 plain and the same size full universal, motor driven. This drill demonstrates the most rapid advancement that has been made in this class of machinery, and introduces a great many entirely new features that will be described later. They also have on exhibition a No. 1 radial, a four spindle multiple drill and a Norris multiple spindle gear cutter, with two each plain and universal heads. These machines are all in full operation.

George Jeungst & Sons Co. exhibit their latest lever crank, back-geared shaper, with improved extension base and table support, and a friction machine with 26-inch stroke. These shapers, of which we are the sole selling agents, have many advantages not usually offered in this class of machinery and are most complete in every detail.

We may add that our superstructure is worthy of note, as it represents a type of machine shop construction which has been adopted by many prominent concerns in Cincinnati. The three line shafts are supported on eye channels, being held in position by means of slotted cast iron brackets, which permits both lateral and horizontal adjustment, with ease. The shafting, hangers and pulleys are exhibited by the Medart Patent Pulley Company, of St. Louis.

On the suggestion of the Dodge Mnfg. Co., Toronto, manufacturers of friction clutch pulleys and couplings, we reprint the substance of a paper read before the New England Manufacturers' Association by R. H. Hill. To construct a good efficient friction clutch of any class requires a great deal of patience of the cut and try order until the parts are so constructed and balanced that the clutch will back up the principle involved and when put on the market it will not be a source of annoyance on account of the weakness of some apparently unimportant part. I would advise that when you get your clutch, be sure it is fitted by a careful and exact machinist who is well acquainted with the clutch in hand. Provide solid, substantial foundations, and in the case of large friction cut-off clutches use a connecting bed plate for the bearings on each side of it, and when it is erected, be sure the shafts are in perfect alignment and that they will be held there.

The growth of the friction clutch industry has, like many other good things, been phenomenal. It is my firm belief that there has been manufactured and put upon the market a larger value and greater number of friction clutches in a single day in the year 1900, than was produced in the whole year of 1875. The general introduction and use of electricity has been largely responsible for the increased demand for first-class friction clutches. The high speeds at which they are invariably run in electrical generating plants, and the extremely severe duty required of them for this class of work has brought out the best efforts of our mechanics in producing satisfactory running clutches. It has been one of the best advertising mediums of the friction clutch business, and has, in many instances, shown to enquiring minds the advantage of the adoption of friction clutches in other channels of work.

It is an accepted fact that no first-class builder of machine tools, or of any other machines that need to be stopped and started frequently, does not find it to his advantage, as well as to his customer's, to use friction clutches to operate the said tools or machinery. Compare the ordinary engine lathe, built on modern lines, having a good friction clutch pulley countershaft, with that old annoying arrangement having a jaw-clutch pulley countershaft. The slam-bang noise of one of these pests when in use in a shop is enough to put the men's nerves on edge, to say nothing of the hard labor and skill necessary to operate it and the liability of spoiling the work in hand.

Go a step further and compare the modern friction clutch pulley countershaft with the old tight and loose pulley affair with its shifting, sluggish, squealing belt, which is continually wearing out and breaking down. Note the ease with which the operator controls the machine having the friction clutch device. He can do more work, better work, with less exertion and less wear and tear on the machine and belts. Yet it is not such a long time since the manufacturer, and even the operator, thought the old jaw-clutch or tight and loose pulley device on a lathe was pretty good. The fact is, they did not know of anything better. It is human nature to judge by comparisons, and the enlightenment in the use of friction clutch devices, their advantages on a lathe counter or any other machine, is the reason of the ever-increasing demand for the many thousands of friction clutches manufactured annually and the enormous increase in the number of willing buyers.

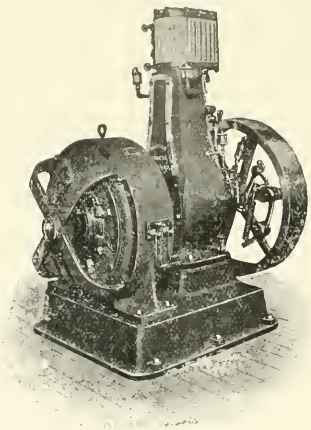
DIRECT-CONNECTED GENERATING SET.

Economy of steam consumption is, of course, a most vital consideration in the performance of an engine, for upon that depends the coal bill. It often happens, in addition, that installation conditions demand economy of floor space.

The accompanying illustration shows a type of engine which the makers claim fulfils both these requirements in the highest degree. It is a standard upright Class "A" engine manufactured by the Buffalo Forge Co., of Buffalo, N.Y., and in this case is connected to a generator of the Triumph Electric Company's make, though it will be understood, of course, that any standard dynamo may be so attached.

The rigid cast-iron frame of the upright enclosed type has one cylinder head cast a part thereof, and to this is bolted the cylinder and steam chest, though in the smaller sizes the cylinder also is cast on the frame. Cylinder and guides are bored with the same setting of the boring bar, so that perfect alignment cannot but result. The material employed throughout is the very best attainable, while the workmanship is high in like degree. A unique feature of this upright engine is that it is

enclosed to run in oil, so that perfect lubrication of the main bearings, crank-pin, wrist-pin and guides is assured. Other bearing surfaces are cared for by continuous oilers of large capacity, and for the cylinder and steam chest, a large sight feed lubricator is provided. As a result of this thorough system, smooth running at continuous high speeds is readily possible. Detachable side plates give an oil and dust proof en-



closure, and at the same time permit of ready access to the moving parts. Another feature which renders this engine valuable for high-speed lighting and power service is close regulation. This is afforded by a centrifugal fly-wheel governor of great sensitiveness. The latter property follows in part from the careful design, which provides three means of adjustment for the governor, and in part, also, from the provision of ample lubrication for all the governor pins and rubbing surfaces of the valve motion. The valve, it may be added, is of the piston type, perfectly balanced. In view of the illustration herewith shown, it is hardly necessary to comment upon the extremely small floor space required for such a generating set. This feature has resulted in the extensive application of the Buffalo Forge Company upright engine to marine service, where the requirements are especially severe. The machine in question has a range of sizes from 4 to 100-h.p.

POINTS ON CEMENT.

W. R. Butler, C.E., Toronto, recently gave to the Canadian Society of Civil Engineers the following abstract of papers on cement, read before British engineering societies:

In the first paper, the importance of fineness of grinding is particularly emphasized, and its effect upon the cementitious value is discussed at some length; incidentally it is pointed out that fine grinding, as also the process of air slacking, both have the effect of reducing weight, and, in speaking of the value of weight as a criterion of quality, the author shows that insistence upon a certain standard weight may sometimes lead to the acceptance of a hot (or imperfectly air-slacked) cement, or of one of inferior fineness. Variations in the weight of samples of the same cement, weighed at different ages, are given, as follows:

Age	Weight per Bushel.
One day	117 lbs.
One month	113 "
Two months	108 "
Twelve months	103 "

And, as examples of variation in weight due to grinding to different degrees of fineness, the following are quoted: A cement leaving 10 per cent. residue in an 80 mesh sieve weighed 110 lbs. per bushel; one leaving 20 per cent. weighed 116 lbs.; one leaving 25 per cent. weighed 121 lbs., and one leaving 35 per cent. weighed 123 lbs.

The author considers that the chief value of chemical analysis, as capable of application by the average user of cement, lies in the easy detection, by its means, of the presence of sulphur, or magnesia, in dangerous quantity; beyond this, the tests which he regards as of the greatest practical importance are those for (1) Fineness; (2) Soundness; (3) Tensile strength. The economy is referred to of securing a finely ground cement rather than one containing a sensible proportion of a practically inert substance, or of particles the complete hydration of which, in the author's opinion, may be so long delayed as to endanger the integrity of the mass when this hydration finally takes place; at the same time the wisdom is questioned of pushing the demand for fineness to an extreme; firstly, because the manufacturers can meet the demand by using a softer clinker, and, secondly, because of the practical difficulties in the way of testing the exact fulfilment of such demands. Not more than 10 per cent. residue, by weight, upon a 5,800 mesh sieve is suggested as a sufficiently exacting test of fineness for practical purposes. The author's experience has given him the utmost confidence in the reliability of the "Prussian" or "Pat Test," in conjunction with "Faija's Steam Test," as applied to Soundness. In discussing the value of tests of tensile strength, the quick development of strength which is exhibited by an over-limed cement is noticed, and an instance is quoted in which strengths of 330 lbs. in water and 740 lbs. in air were attained by a certain cement, after 28 days; the briquettes, however, afterwards suffered complete disintegration through subsequent hydration of free lime. The indication of real value, it is pointed out, is that of a fair induration after seven days; the exhibition, say, of a tensile strength of 350 to 400 lbs. per square inch—with an increase of strength of at least 30 per cent. in 28 days. Attention is called, in the paper, to the effect, upon the apparent strength, of the rate at which the scale is loaded in the testing of briquettes; a slow loading from zero upwards generally leads to a lower "breaking weight" than if the test is begun with an initial loading, equivalent, say, to 100 lbs.—it is the author's practice to begin with a load of 100 lbs. applied in 15 seconds—examples of these variations are given. The difficulty is referred to of carrying out "sand tests" in accordance with any standard, as sands of quite different character may each of them equally well fulfil almost any washing or sifting tests that can be applied to them. In the discussion upon the paper, however, the importance of the retention of the sand test was a good deal emphasized, notwithstanding its difficulties, particularly as it might often serve to detect the presence of adulterants. The effect upon the tensile strength of the addition to the cement of dilutents, such as pure sand, or Kentish rag, might be hardly perceptible until the further addition of sand had increased the total quantity of inert matter to a certain proportion, but after this proportion has been exceeded, the further addition of sand leads to a much more rapid reduction of strength than is shown by the same additions to an unadulterated cement. The addition of any adulterants, such as sand, slag, ragstone, etc., the author condemns most emphatically; he quotes instances showing the danger of the presence of slag in a cement which is to be used in damp situations, and it is also shown how the addition of such adulterants must of necessity lessen the cementitious value of the material which fills the interstitial spaces in a rightly proportioned aggregate. The presence of ragstone can be detected by its effervescence with hydrochloric acid, and by the dark green color of fracture in a briquette, when broken after immersion in water for seven days. A test for the presence of ragstone formulated by Mr. Yardley, analytical chemist, is given as under: "Place on a clean silver coin a thin layer of suspected cement, drop a small quantity of dilute H_2SO_4 on it [$H_2SO_4 + 7\ H_2O$], then rinse with water. If the cement is genuine, the treatment with acid will slightly affect the color of the silver, but if slag is in strong proportion, a dark brown stain will be produced on the silver. In the discussion on this paper difference of opinion was expressed as to the relative order in importance of the three principal tests discussed by the author, viz., fineness, soundness, and tensile strength, and also with respect to the best practical standard of fineness, a smaller residue upon a coarser sieve than a 5,800 mesh received some advocacy, say $2\frac{1}{2}$ per cent. residue upon a 2,500 mesh—the gauge of the wire also to be duly specified. It was generally agreed that tensile tests,

to be truly satisfactory, ought to cover a long period, and ought to reveal a gradual and progressive induration.

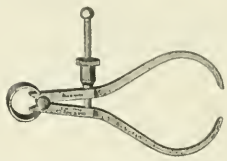
The author of the other paper discussed the observed effects, upon the time of setting of a cement, produced by the solution in the gauging water of such substances as soda, bicarbonate of soda, sugar, salt, and glycerine, in varying quantities. Soda was found to produce a marked acceleration in the setting, when added to the neat cement in the proportion of 1.44 per cent. The experiments were carried out with two different samples of cement, the chemical analyses of which are not, however, given; in the cases of both the effects were very similar. The time of setting was reduced, in the one case, from 0.5 minutes to half a minute, and in the other case, from eight minutes to one minute; complete setting taking place in both cases in one hour and forty-eight minutes. As the quantity of soda was increased above 1.44 per cent., the setting in the case of both cements was retarded, though it was still more rapid than when pure water was used in gauging; all of the other above-mentioned ingredients had a decided effect in retarding the process of setting. Experiments upon the effect of such additions upon the tensile strength had, at the date of the paper, only extended over a period of 50 days; they showed a perceptible diminution in strength in the case of the soda briquettes, but a striking parallelism between the curves of induration (plotted to time ordinates), of the pure cement briquettes, and the soda briquettes, respectively. The great value, under some circumstances, of a reliable means of securing rapid setting, was commented upon in the discussion of the paper. The fact indicated by the experiments seems to be that the addition of a small percentage of soda to the gauging water will have a marked effect in the acceleration of the process of the setting of a cement; and, as many cements naturally contain a small quantity of soda, the quantity to be added to produce the best results will probably vary from 1½ to 2½ per cent.

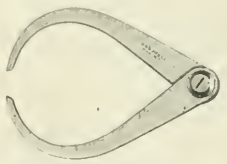
COLD WATER PAINT.

W. A. Fleming & Co., 771 Craig street, Montreal, have recently concluded arrangements for the general distributing agency for the widely known Lythite Cold Water Paint and National Wall Coating. Lythite, although only a dry powder, when mixed with cold water produces a perfect paint suitable both for interior and exterior work. It is made in white and black and 24 colors. White Lythite is the whitest white paint made. Its great value will readily be seen therefore, especially for the interior walls and ceilings of mills and factories, railway buildings, engine rooms, store-rooms, elevator shafts, area-ways and hosts of other places, especially where the greatest possible amount of light is required. This paint increases the light and reduces insurance wherever used. It is absolutely fire-proof, and gives a coating as hard and firm as steel, one that will not crack, rub or peel off. Messrs Fleming & Co. invite correspondence on Lythite Cold Water Paint from the owner of the humblest cottage to the owner of the largest mill. This well known paint is both cheap and economical. It costs about one-fourth the price of oil paint. Many people owning stables, sheds and out-buildings which have never been painted at all, now no longer hesitate about painting on account of the question of cost, when it can be done so cheaply with Lythite Cold Water Paint. Hospitals, jails, theatres, sanitariums and public institutions of all kinds cannot afford to overlook this product. In addition to all the other merits it is a very excellent sanitary coating. For use on calcimined and plastered surfaces the best thing made is National Wall Coating, Lythite's little sister. This wall coating has great covering power, will not run, lap or show joints, and possesses great sanitary properties.

CALIPERS AND DIVIDERS.

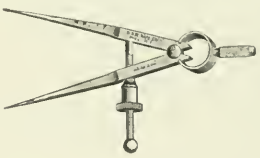
The difficulties confronting the manufacturer who undertakes to improve the time honored spring calipers are readily appreciated. When it is taken into consideration the number of years that this variety of tool has been in use, and the advancement made in their manufacture and adaptation to the needs of the machinist, it would seem almost impossible to improve such an output. However, more than two years ago the Brown & Sharpe Mnfg. Co. undertook the problem; and, with what results can best be appreciated by an inspection of "Brown & Sharpe" calipers and dividers recently placed upon the market. The same care and attention to every detail of manufacture is given this output that has made their machinists' tools, as well as machine tools, the recognized standards for accuracy and efficiency. The essential features to be embodied in a tool of this character are undoubtedly, first, design; second, workmanship, and third, quality, all three of

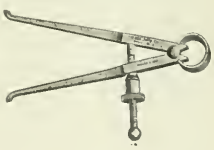




which have been faultlessly combined in this latest line of machinists' tools. In design, they are pleasing to the eye; and, while light in appearance, they are at the same time substantial. Sharp corners that are easily nicked and otherwise defaced are carefully eliminated. It is hardly necessary to mention the workmanship, as the high standing and quality of their machinists' tools is so well known, but we will say briefly that the workmanship is shown by the care taken in the manufacture of the various parts, as well as in the finished product, while the quality is evinced not only in the materials employed in their construction, but in the complete way they meet the most exacting requirements.

The spring is of improved form, unusually stiff, and especially tempered to withstand severe service. The ends of the spring terminate in convex lugs that fit into concave grooves, accurately milled in the ends of the legs. This method of construction ensures the spring being held firmly





in place, and prevents the legs from springing sideways. With the spring dividers, for example, it is possible to describe a circle with practically no side deflection of the points. The legs are steel drop forgings, and every care is taken to have them uniformly finished. The spring nut used on these calipers is entirely new in design, and is constructed on the principle of the spring chuck with the jaws hardened. It is positive in action when closing, and the thread engages the screw with the slightest pressure upon the end of the jaws, while the withdrawal of the pressure causes the nut to release

at once, without regard to the manner in which it is held, the nut then sliding freely on the screw. The screw, next to the nut in importance, is of steel, carefully hardened to prevent wear. It is dust proof, and combines all the security and smoothness of movement that the solid nut possesses, with the added advantage of quick adjustment. A thumb attachment is provided for the spring dividers. The firm joint calipers also recently placed upon the market by this firm show the same care taken in their design, workmanship and quality as with the Brown & Sharpe calipers and dividers

The Waterloo, Ont., branch of the Canada Woolen Mills Co. is building an addition, 35 by 60 feet, two stories high, to be used as a shoddy mill. It will also increase its steam power.

AN AUTOMOBILE EXPLOSION.

A new danger has developed in connection with the automobile, which was demonstrated by an accident which recently occurred at Toronto. As James O'Brien, one of the city letter carriers, was going his rounds, collecting the mail from the boxes, on one of the motor vehicles furnished by the post-office, the side of the carburetter, the compartment where the gasoline is vaporized, blew out. The driver took in the situation at a glance, and upsetting the machine opened the gasoline reservoir, which contained about a gallon and a half, and allowed it to flow out. The gasoline took fire, and burned the paint off the machine and the pavement. Though the carburetter was between the rider's legs he escaped without injury, but his promptness prevented further damage. This is the first time such an explosion has occurred in any of the post-office automobiles.

WATER-TUBE BOILERS.

Editor CANADIAN ENGINEER.

Sir,—The article in your issue for September on the subject of "Water-Tube vs. Fire-Tube Boilers," quoting from an article on the same subject in The Engineer of London, has doubtless proved interesting to many of your readers, and especially to those of them whose avocations bring them into contact with the theory and practice of steam production. The conclusion at which many have doubtless arrived after reading the article in question, is, that the recent trials of Her late Majesty's ships Hyacinth and Minerva have shown that water-tube boilers are inferior to those of the Scotch cylindrical type. Further investigation, however, will soon convince any unbiased mind that certain types of water-tube boilers possess the very features cited as essentials of the ideal boiler. From the fact that the Belleville boilers of the Hyacinth did not clearly show themselves to be superior to the Scotch boilers of the Minerva, it is of course wrong to conclude that all types of water-tube boilers are no better than fire-tube boilers. Unfortunately, this erroneous conclusion is the one most likely to be come to by those of your readers who have not had the opportunity of following the recent developments of the subject.

While most types of water-tube boilers have been unsatisfactory for the severe conditions which prevail in naval work, it must not be overlooked that certain water-tube boilers have given most excellent results, which have led to their adoption on an extensive scale. The law of "the survival of the fittest," applied to the boiler problem, has already operated to such an extent that those who are acquainted with the facts can predict the outcome with every confidence that their predictions will be fulfilled. While the trials of the Hyacinth and Minerva may appear inconclusive, they only confirm the experts' opinion that properly constructed water-tube boilers must inevitably supplant the Scotch boiler. The prominent features of the latest water-tube construction, as developed in the "Babcock" boiler, are: Light weight, combined with large heating and grate surface; rapid steaming properties with absence of priming; freedom from unequal expansion and contraction; suitability for the high steam pressures required for modern engines, combined with absolute safety; economic utilization of the calorific value of fuel; accessibility to all parts for cleaning and repair; in short, it is a boiler that can keep at sea a long time without needing any repairs. It may safely be said that these conditions have been fulfilled in every detail, within the last few years.

It is perhaps well that your readers should be reminded of the recent reports of the Committee of Experts appointed by the British Admiralty last year to advise upon the merits of various types of boilers. The result of their investigations was that they recommended that the "Belleville" boiler should be entirely discarded for the future; and that trials be made of the "Babcock & Wilcox," and two other less known types. In this connection, it may be mentioned that "Babcock" boilers were installed in Her late Majesty's ship Sheldrake in 1898, and elaborate trials have been made with these boilers under all conditions of service. This vessel is a torpedo gun boat, having twin screw triple expansion engines indicating collectively about 3,000-i.h.p. On trial, 4,050-i.h.p. was obtained, when burning about 25 pounds of coal per square foot of grate per hour, with a coal consumption of 1.57 pounds of coal per i.h.p. per hour; and it is worthy of note that it has not been necessary to replace a single tube in these boilers on account of defects. The recommendations of the committee were doubtless to a large extent based upon the excellent results obtained with these boilers; and as a consequence, the Admiralty have since ordered "Babcock" boilers for the battleship Queen, the first-class cruiser Cornwall, the second-class cruisers Challenger and Hermes, and the sloops Espeigle and Odin, aggregating over 60,000-h.p. In adopting the Babcock boiler the British Admiralty are following the example of the United States navy, which has already ordered 160,000-h.p. for various battleships, cruisers and gunboats.

The facts above cited speak for themselves, and will doubtless tend to correct the impression abroad among many who are acquainted with recent developments as to the supposed inferiority of the water-tube boiler compared with the Scotch boiler. While the Scotch boiler has proved a faithful servant in the past, its inherent defects are a constant source of trouble; and in these days of modern progress, it is only to be expected that it must be entirely superseded within a comparatively short space of time. The Scotch boiler is ponderously heavy, it is uneconomical, very costly to repair, unsuitable for high steam pressures, and the excessive strains resulting from the difference in temperature between the top and bottom, especially when raising steam quickly, render it extremely unsafe for use with the high pressures demanded by modern engines. On the other hand, the "Babcock" water-tube boiler is admirably suited to high pressures, and the circulation is such as to ensure equality of expansion and contraction, which results in the entire absence of injurious straining. The only repairs likely to be needed are of a trivial nature, such as the replacing of a tube, and can be easily carried out by ordinary mechanics without any special appliances beyond a tube expander; moreover, repairs of this nature are very seldom necessary. The reason that the tubes gave out so frequently in the "Belleville" boiler was doubtless due to the system of circulation, which necessitated the water passing through a tortuous path, the flow being reversed about fourteen times before reaching the steam collector. Under these conditions it is easy to understand that over-heating might readily occur, due to the formation of steam bubbles in the tubes. In the "Babcock" boiler, it is well-known that the circulation is free and unimpeded. The great importance of this subject to engineers and steam users is the writer's excuse for trespassing upon your valuable space.

LEONARD R. FLINT,
Manager Babcock & Wilcox, Ltd., Montreal.
September 20th, 1901.

—One of the features of the new power house of the Washington Agricultural College and School of Science, Pullman, Wash., is a special Sturtevant steam fan for producing draft on the induced principle for 580 h.p. of boilers. As is the case in several other technical schools this mechanical draft apparatus was installed in part for the purposes of instruction and as a means of acquainting the students with the advantages of this forceful competitor of the chimney.

YUKON RIVER IMPROVEMENTS.

Extensive improvements in the matter of dredging and damming are about to be undertaken on the Upper Yukon, under the direction of Superintendent Tache, of the Public Works Department. The chief work contemplated is the completion of the 1,000 feet of dams to confine the water at the head of Lake La Barge in one deep channel, the removal of one of the fingers at Five Fingers, and three boulders from the Thirty Mile river that are a great menace to navigation. The work of dredging the channel at Upper La Barge is now in progress. All told there have been nearly two hundred boulders taken out of Thirty Mile. Some little work has already been done at Five Fingers, and it will be concluded after the river freezes. Nothing is to be done to Hell Gate until next season.

GERMAN HIGH SPEED ELECTRIC RAILWAY.

BY O. LASCHE, CHIEF ENGINEER, ALLGEMEINE ELEKTRICITATS GESELLSCHAFT.

(Concluded in next issue).

The high-speed electric railway car of the Allgemeine Elektricitats Gesellschaft, Berlin, is now ready to be placed upon the track and subjected to actual running trials. A stationary test of the car upon rollers in the factory has been made, and the operation of it under these conditions has fully answered all expectations.

The studies and experiments of the association for studying electrical high-speed railways have, up to the present, assumed but a general character, and do not refer to the equipment of any particular line. It is intended to begin within a short time the trials on the military railway track Berlin-Zossen, which has been kindly placed at the disposal of the association by the Imperial Railway Military Board of Administration.

The speed of 125 miles per hour has been assumed as the maximum velocity because of the present construction of the car, but it must not be inferred that the main object consists in the attainment of that speed or that there will not be any possibility of making the trials at a still higher speed. The trials, however, have for their special object the establishment of a sure basis for projecting, constructing and working electrically lines at speeds which are common at the present day, or still higher. In technical journals and newspapers the speed of 125 miles per hour has been ridiculed as impossible of attainment; on the other hand, it has been often asserted that this speed can be reached by steam locomotives, Americans claiming, as is known, to be able to travel at a still greater rate. In view of the present requirements of traffic, efforts must, of course, be made to travel faster, but especially must traveling be made more convenient for the public, and for this purpose electricity is best adapted. Of course, the object of the present trials and of the operations during the next few years will be to ascertain the economy of an electric system of working, as compared with the present steam working system. It must be ascertained in what proportion the total costs stand at different velocities, and especially at the higher velocities. Cost was not considered the main point when electric light and electric power were introduced, and even up to the present day the electric light is often much more expensive than other forms of illumination, yet electric lighting occupies a very wide field of activity. In the same manner cost will not be the first consideration in the introduction of an electric system of working existing railways, but rather the convenience afforded by such a system. From this beginning the introduction of electric long-distance traffic will be easily developed and become universal.

A rapid succession of separate motor cars is one of the most obvious advantages of an electric system of railways, and this method of working is proposed both for suburban and long-distance lines. For this reason, therefore, the trial cars of the association have been built as passenger cars and not as locomotives. This quick service system is already needed for the convenience of the public and will be gladly paid for by them.

Lines with an increasing traffic will appreciate the advantage of introducing an electric system of working, as with such a system it will not be necessary for them to strengthen either their tracks or their bridges, since instead of meeting the increasing traffic with heavier locomotives and longer trains, a quick service system of light and separate motor cars can be introduced, with the additional advantage of freedom from smoke annoyances.

The track and its maintenance are, of course, very important points in a high-speed electric system of railways, and many considerable improvements will be necessary, although the trials shortly to be made will prove the comparative requirements of electric motor cars and steam-driven trains.

The coming experiments are expected to establish a basis for the calculation of the working expenses of electric main lines, the outputs of motors for the various speeds with the increasing influence of the air resistance, and for the size of the necessary power station. Of the limit of the minimum speed at which the electric system may be more economical than the steam locomotive system, about as little is known as the limit of the maximum speed. It is only known that with steam locomotives the consumption of steam and especially the consumption of coal is largely increased as the speed grows. By centralizing the generation of power the case will, of course, be entirely different. The best large steam engines may be used, and boilers with superheating and feed-water heating apparatus. This centralization is possible for very long distance lines, and consequently also the attainment of a practically uniform load.

Electric energy may be economically transmitted to very long distances by three-phase alternating current at 40,000 to 50,000 volts, and further extensive railway systems can be supplied with energy from a central station placed in the most favorable situation.

CHOICE OF THE SYSTEM.

Owing to the long distances through which it may be necessary to operate, the system to be adopted is three-phase alternating current of high potential. For the present experiments a voltage of only 10,000 to 12,000 is necessary. The current is supplied by the Oberspree Central Station of the Berlin Electricity Works, the distance from the station to the point at which the overhead line is fed being about 15 km. Transformers are mounted in the car by which the voltage impressed upon the motors is reduced to 435 volts.

As to further constructions, it remains an open question whether it is advisable to keep the heavy weight of the transformers within the car. It may be preferable to reduce the high tension of 50,000 volts by transformers placed in houses alongside the track to a medium tension of about 3,000 volts and to wind the motors for this voltage.

The transformation of three-phase currents into direct current is not practicable for feeding long-distance railways, since it necessitates the use of motor-generators or rotary converters which require attention. Furthermore, the direct-current system can be used only at low voltages and therefore transformer stations are required at frequent intervals along the line to avoid excessive losses. It may prove necessary to use direct current where the long-distance motor cars pass through cities. The overhead wires required by the three-phase system are inconvenient for branches and switches, and therefore it may be necessary in such cases to shunt a low-speed locomotive operated by direct current in front of the car.

The problem set to the Allgemeine Elektricitats Gesellschaft was to construct a motor car for a speed of 125 miles per hour, and to accommodate 50 persons. The car has two bogey trucks with three axles each, and the motors are designed for a total normal output of 1,100 horse-power and 3,000 horse-power maximum. The electric current provided is three-phase, at a tension of 12,000 volts, and with a frequency of 50 cycles per second. The weight of the cars was required to be as small as possible, and by no means to exceed eight tons per wheel; and the cars were required to conform to certain dimensions to pass over the lines of the State railway.

The car cannot be compared in any way with the ordinary tram car or low-speed locomotive, its electrical equipment including the motors, transformers, and the starting and regulating arrangements, being of an entirely new and novel construction. It has been built, however, in such a fashion that after the experiments on it have been carried out it can be put into actual working use.

In order to obtain the lightest construction of car and of the electrical equipment a long series of experiments and designs were made before the final form was adopted. In view of the desired high speed, the A. E. G. thought it necessary to find means to relieve the axles from the heavy weights of the motors, or at least of preventing the axle from being directly burdened by this weight.

The starting and regulating apparatus for 3,000 horse-power could not be constructed according to the types of the usual car controllers having to deal with an output of hardly 100 horse-power. Elaborate and costly experiments were

necessary for testing the entirely new constructions which were designed.

The braking at a speed of 125 miles per hour by means of friction brakes, that is, at a friction speed of 56 meters (183 feet), per second, was found impracticable, and it appeared necessary to provide means for braking electrically as well.

Quite a number of further new details had to be designed. The motor bearings have to work at a speed of about 14 meters (46 feet), per second, the slip rings of the armatures at a speed of 40 meters (157.5 feet). The trolleys constitute another new detail, which may be considered as one of the most difficult problems to be solved.

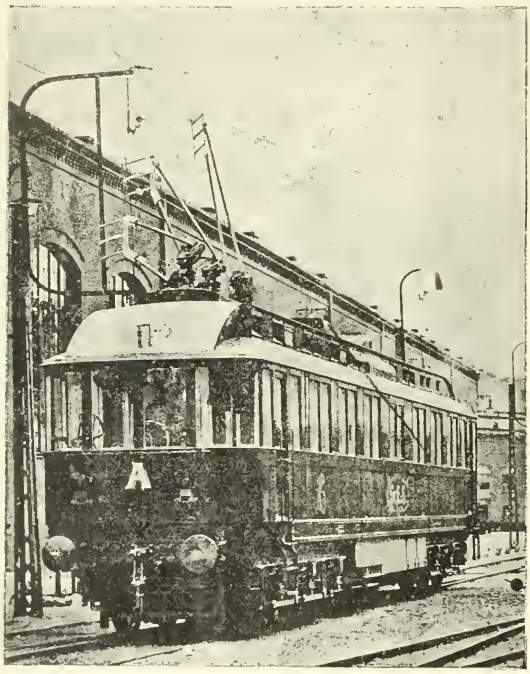


Fig. 1.—Zossen A. E. G. Car.

WEIGHT OF THE ELECTRICAL EQUIPMENT.

As to the arrangement and especially the designs of the body of the car, at first it was proposed in view of the conditions of running in both directions, forwards and backwards, to construct at each end of the car a driver's cab, in which the necessary starting apparatus was provided. The construction was so arranged as to enable the driver to control the entire electrical equipment of the car from the front starting device. This arrangement, however, proved impracticable, owing to the quantity of cable required, considering that 3,000-h.p. had to be controlled. Matters were facilitated by dividing the electrical apparatus into two circuits and operating the rear starting device at a distance, either by an electric motor, compressed air, or water pressure.

In one design considered, the working compartment was of two stories, the lower one for the necessary apparatus and machinery, and the upper one for the driver and the starting and regulating apparatus. These arrangements prevented the driver from inspecting the track within 30 meters (98.4 feet) of the front of the car, and although such inspection is of no great use in consideration of the high speed at which the car is to travel, yet the design was altered and a driver's cab provided at each end. It is especially desirable in consideration of the high speed of the car, which would make a side lookout very trying to the eyes, that the public should be provided with a lookout at the ends of its body, and therefore, although there is a cab at each end, it is so arranged that lookout windows are left.

All apparatus, cable and safety devices are arranged in the space in the middle of the car. This room, and also the transformers built below it, are separated from the passengers' compartments by air shafts having double iron walls. The driver always stands at the front of the car, apart from the passengers, in a room containing no parts under high voltage. The controlling is effected from the cab by a system of mechanical transmission. It has already been stated that the transformers had to be mounted in the car, although their weight is extremely inconvenient and considerably increases the total weight of the motor car. In the calculation of the transformer windings and the cross sections of the iron, the question of the heating of these parts and its dissipation is of the greatest importance. The cooling of the transformers by air taken from below the car is impossible, on account of the great accumulation of dust when traveling at a high speed. On the other hand, the designs showed the great difference in the weights when air is passing through the cores of the transformers in contrast with the insignificant cooling obtained when only over the surface of the casing. Two air shafts are led from the roof of the car to the transformers in such a manner that the front shaft is used for admitting fresh air and the rear shaft as an outlet for the heated air. Special care has been taken for shielding the motor from the air in rainy weather and for drying and filtering it before it enters the channels of the transformers, although actual contact of the cooling air with live circuits is avoided. Further economy in weight resulted from the use of a liquid starting device of an entirely new construction, instead of a metal starting device with coils or strip resistance material, such as was at first provided.

The following brief summary shows how the weights varied in the different investigations:

Weights.	I. Pounds.	II. Pounds.	III. Pounds.
Four motors	37,274	35,274	28,218
(a) Two transformers	28,660	28,660	14,330
(b) Starting resistance with casing (c) Two controllers with driving mechanism	19,841	19,841	10,471
(d) Braking and lighting batteries	5,732	5,732	5,732
(e) Motor with compressor	1,763	1,763	1,763
(f) Oil pump	441	441	....
(g) Oil tank	1,322	1,322	....
Total weight of cable	8,818	2,204	2,204
Collector bows	3,086	3,086	3,086
Summary	104,939	98,322	65,808

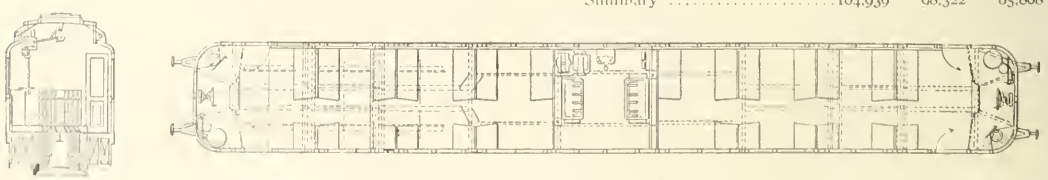


Fig. 2.—Plan and Cross Section of Car.

The final weight of the transformers was 6.5 kg. (14.3 lbs.) per kilowatt, and of the motors 13 kg. (28.6 lbs.) per horsepower of the normal output and 4¼ kg. (9.47 lbs.) per horsepower of the maximum output. The table also shows the economy which resulted from the construction of the motors (Fig. 3), without a closed casing. As with the new types of alternating-current dynamos and stationary motors, the iron of the magnetic circuit is not covered by the usual casing, but is directly exposed to the air, the cooling surface of the motors being enlarged by the provision of ribs. The surface

cooling is therefore very excellent and fully sufficient for the continuous running of the motor. There is no provision made for the admission of air into the motor, as on account of the dust it is not possible to take the air from below the car, and the supply of air from above could only be arranged in a very inconvenient manner.

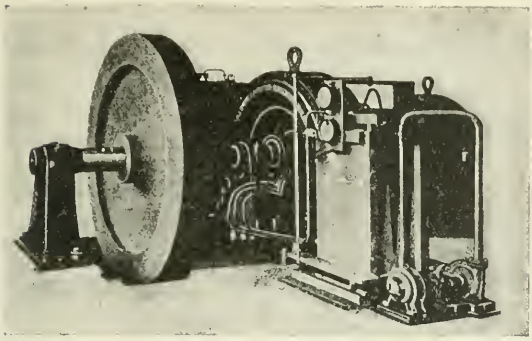


Fig. 3.—Experimental Form of Starting Device.

STARTING DEVICES.

In the remarks concerning the main division of the car and arrangement of the electrical apparatus having regard to the attainment of the smallest weights, it was mentioned that the starting apparatus was mounted in the middle of the car so as to shorten the cables as much as possible. The primary circuit of the motors is provided with a switch for reversing the direction of running, for cutting out and for braking the motors by counter current, or by connecting the circuit of the field frame to a storage battery.

The problem of the starting resistance for 3,000-h.p. was finally solved by a liquid starting device on quite a new principle. Fig. 4 shows the corresponding experimental arrangement. A threephase motor of 200-400-h.p. is coupled direct to a very heavy flywheel. For making this run up to full speed in 15 seconds a torque corresponding to an output of 400-h.p. must be attained. With the same output, another heavier flywheel is made to run up to full speed in 1½ to 2 minutes. The former meets the requirements of a hauling engine, the latter the requirements of the high-speed car. The high-tension switchboard is arranged in the background, wherefrom the winding of the motor is connected for backward and forward motion. A combination of these connections with the starting device proper was omitted in this experimental arrangement. The cut shows in the foreground a small centrifugal pump driven by an electric motor, which withdraws the liquid from a tank located in the basement and continually delivers it into the superposed tank in which the electrodes, i.e., the terminal or end plates of the opened armature circuits, are located. The pump operates continuously, hence a continuous renewing and mixing of the liquid takes place, the electrodes are thus suspended, not in stationary, but in moving water. By shifting the somewhat primitively arranged vertical rod to the right, a valve located in the bottom is closed, through which, when open, the water is continuously discharged. The liquid now begins to rise in the tank, i.e., the armature circuits are closed, whereby a considerable resistance remains switched in. The motor starts, as the liquid rises further the interposed resistance decreases and the motor runs quicker. Consequently, for a certain load of the motor each height of the liquid level represents a certain speed. By means of a regular overflow in the electrode vessel, the level of the liquid, and consequently the speed of the motor can easily be adjusted.

The electrode plates are at the lower end, very wide apart, and made with prongs of different lengths. The arrangement is such that the longest prong of the first plate is situated diagonally opposite to the longest prong of the other electrode. Thus at the beginning, not only is the dipping surface small, but especially the distance or the path of the current through the liquid, is very long. The immersed surface of the plates can therefore be considerably larger on account of the great distance than might be the case for the passage of the same quantity of current through a short path, i.e., the specific passage from one plate to the other of the current through the liquid is reduced. In consequence thereof a flashing of the points or tips such as occurs with the old construction has become impossible. On the other hand, the electrode plates are put very close to each other at the top, and besides, more plates are used in order to keep the current conducting surface very large, thereby reducing to a minimum the resistance set up by the liquid to the passage of the current. It is thus not necessary to use metallic short-circuiting contacts. The essential difference between the new starting device and the previous ones consist in keeping the liquid in constant motion, and this fact alone ensures its success. The heated liquid does not remain at the part where heat is generated, but is constantly moved and mixed afresh. It can be easily calculated what amount of heat is delivered to the liquid by the resistance at a certain load and a certain decrease of the normal speed. On the other hand, water in motion renders it possible to conduct away the troublesome heat in a very simple manner. The cooling surface necessary to do this may be calculated. For instance, according to the present construction in the high-speed car, a copper coil of small diameter is provided through which the heated water has to pass after its exit from the electrode vessel, and before it is used afresh. Consequently, the new liquid starting device enables any suitable large resistance to be introduced into the circuit permanently, i.e., the motor can continuously run at any desirable slow speed. The starting time of the motor, viz., the time up to which the resistance is entirely cut out, is determined by the speed at which the liquid flows to the electrode vessel. By inserting an

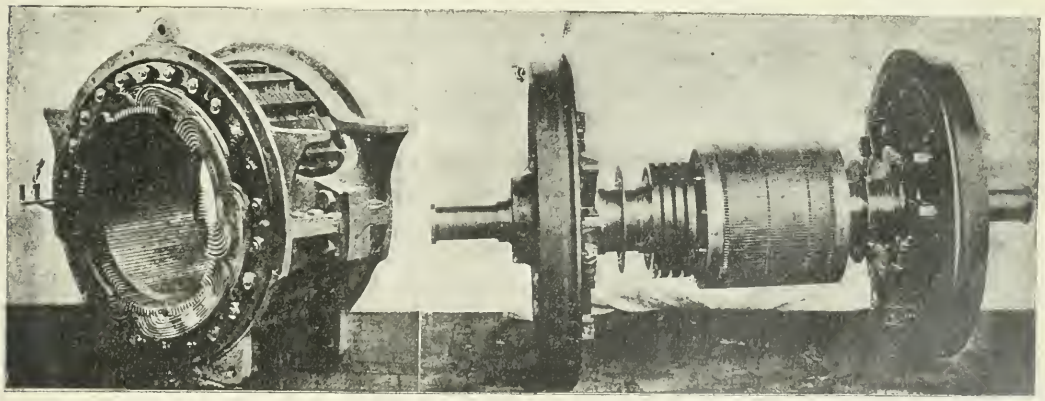


Fig. 4.—Motor Field and Armature.

adjustable cut-off device in the pipe leading from the centrifugal pump, the speed at which the liquid is delivered and consequently the starting time can be regulated at will. By this construction it is therefore rendered possible to prevent the driver from reducing the time of the starting; hence the acceleration and consequently the momentum of inertia can never prove greater than the overloading capacity of the motor permits. On the other hand, the driver can, by a correspondingly slow or incomplete closing of the foot valve, decrease the speed for starting and braking, to any desired extent. In a similar manner, the driver can run the car at any desired slow speed by keeping the foot valve partially opened. Consequently, he can always regulate the speed. This new construction, when compared with metallic starting devices, also shows the great advantage of a gradual and perfectly regular switching out of the resistance over the intermittent action of the latter. In other words, the starting and braking are effected softly and not by jerks. Any one who has experienced the jerking motion in tramway cars can realize how the above arrangement will be appreciated by the passengers.

Owing to the great simplicity of the apparatus, it can always be readily operated from remote points, as the power required is very small. Consequently, the provision of compressed air or electricity in the car as means for operating the reversing mechanism is obviated. It has only been necessary to provide a connecting shaft operated by a hand wheel from each or both drivers' cabs.

By employing this new system of liquid starting apparatus, metallic resistance was no longer needed. Several hundred contacts and connecting cables were dispensed with, and as regards maintenance, all fear is needless, since the maintenance of plates immersed in a soda solution, and therefore not liable to get rusty, cannot be compared with the maintenance of many and large controller cylinders, contacts, contact brushes, cable connections and pieces of resistance material.

BRAKES.

With the same experimental arrangement constructed for testing the starting apparatus, the system of electrical braking by the motors was also tested. The car is equipped with a Westinghouse compressed air brake, which is divided into two parts for each of the two trucks. The compressed air cylinders are operated from the front driver's cab. The brake pressure is assumed as very high, 170 per cent., because the friction coefficient between brake block and wheel at the high speed of over 50 meters (164 feet) per second is materially different from the friction coefficient at the usual lower speeds. In consequence of investigations made, an appliance has been devised for decreasing the brake pressure at a gradual slow speed. Notwithstanding the fact that in a certain degree the brake device of the one forms the reserve for the other bogey, it was not considered admissible to dispense with a second brake device. This additional braking action was imparted by the motors themselves, and not by special rail brakes or similar less proved apparatus. The braking or retarding action can be effected by means of an electric motor in two different way: Firstly, by eddy current, namely, energizing the field of the motor with direct current and short circuiting the armature; and, second, by reversing the direction of the current in the rotary field. Both kinds of brakes are used in the high-speed car. After the armature circuit is opened by opening the outlet valve on the liquid starting device, the field is cut out and switched on to a storage battery built within the car, or is reversed to opposed current in that two of the three phases are reversed, the series arrangement of the phases being changed from 1, 2, 3 to 1, 3, 2 and 3, 2, 1, respectively. After the switching has been effected in either way, the armature circuit is gradually closed again, i.e., the inflowing liquid connects the phases through very great resistance; and according to the desired intensity of the braking action, the level of the liquid is raised or lowered. The braking with counter current alone did not appear to be sufficient, because the current was liable to fail for some reason or other, for instance, by the blowing of a safety-fuse in the very moment when the brake is applied. The use of counter current has a further disadvantage. In conformity with the electric dimensions of the motor and the potential of about 430 volts selected for the field, the armature has a tension of about 325 volts with open circuit. After the reversal of the field, the tension in the armature increases at the full speed of the latter, to almost double the amount, viz., to about 650 volts. Although the liquid starting device is constructed for this voltage and the motor armature also fully sustains the same—it was tested at 4,000 volts—yet it does not appear proper during the braking action, when there is a possibility of direct danger, to make the safety of the braking action dependent on an unusually higher voltage. These were the reasons which led to the provision of an eddy current braking system, and for this purpose there were also used, analogous to the two separate air receptacles for the Westinghouse brake, two entirely separate storage batteries. It is here assumed that motor braking must be made use of in the event of the high speeds, whereas the air brake is only applied at the end of the run. For shunting service a hand brake is provided, which acts on the front bogey.—Electrical World.

Industrial Notes.

British men-of-war have begun to use Cape Breton coal.

Mackenzie, Mann & Co., will erect another grain elevator at Port Arthur.

Improvements to cost over $100,000 are to be made on the Hamilton Beach canal piers.

A. R. Woodyatt & Co., manufacturers of lawn mowers, etc., Guelph, are enlarging their workshops.

The Montreal Light, Heat & Power Co. has bought out the Imperial Electric Company of Montreal.

One day recently the output of coal at the different mines of the Dominion Coal Company totalled 13,000 tons.

The Canadian Northern railway will at once erect coal docks at West Fort William, Ont., near the steel dock.

Charles Potter, optician, has imported a fine 4-inch refracting telescope for the Toronto Astronomical Society.

The G.T.R. has offered the village of Bridgeburg $1,200 per year for fifteen years for water if the village will put in waterworks.

The by-law to raise $20,000 for heating and lighting the town of Medicine Hat by natural gas was carried by 64 majority.

The Ontario Minister of Education states that the new building for the department of science of Toronto University is to be commenced this fall.

Work is now pushed night and day on the new Toronto hotel. The night force consists of from 150 to 200 men who work under electric light.

The Toronto Board of Fire Underwriters has advanced the rate of insurance upon machine shops and foundries fifty cents per one hundred dollars.

The Globe File Works in Port Hope have been purchased by Americans, and it is feared the industry may be closed up in connection with a trust.

Mr. Edison, who recently visited the Sudbury district, is anxious to secure a property that will produce about 1,000 lbs. of nickel daily for use in his new storage batteries.

Wiarton is to have a beet-root sugar factory, the contract having been let. It is estimated to cost $350,000, and will have a capacity of 350 tons of beets per day.

The Bradford News says that the heating apparatus in the Simcoe county House of Refuge is so defective that a new one will have to be installed at a cost of at least $1,500.

Several United States firms are seeking concessions in Newfoundland with the object of establishing pulp factories. The timber resources of that colony are said to be practically inexhaustible.

The directors of the Dominion Iron & Steel Company met at Sydney recently, and inspected the works. They expressed themselves pleased with the progress of construction, and spoke hopefully of the future.

The Northern Elevator Company will erect a new elevator at Wolseley of 25,000 bushels capacity.

A movement is on foot for the establishment of a binder twine and cordage factory at Almonte.

A supplementary drainage system has been decided upon for Lachine. Debentures will be issued for $37,000 to cover the cost.

A meeting of Sydney ratepayers has instructed the town council to submit a by-law granting a bonus for a ship-building yard.

There are twenty manufacturing concerns in Berlin, Ont., which enjoy exemption from taxation, according to a Waterloo contemporary.

The Petrolia pork packing business is said to be an assured thing, and the buildings will be proceeded with. A new refinery is also to be built in that town.

A despatch from Sydney, C.B., states that the amalgamation of the Dominion Coal and Dominion Iron and Steel Companies will shortly be consummated.

The contract for a new million-bushel steel fire-proof elevator, which the Montreal harbor commissioners propose to erect in the centre of the harbor, has been awarded to J. A. Jamieson, contractor and engineer, for $642,000.

Rev. Thomas Geoghegan, of Hamilton, has reported to Manager Barrow that he has had highly satisfactory results from the use of sewage disposal works sludge for fertilizing purposes.

A new Canadian discovery for the preservation of wood is announced. The cost of impregnating is said to be about 2 cents per cubic foot. The cost of the plant, which can be used at the felling ground, is about $1,000.

A branch of the Welding Compound Company of Paterson, N.J., has been established in Hamilton. The company manufactures powder, which is used in foundries and blacksmiths' shops for the purpose of facilitating welding operations.

The Clergue syndicate intends operating at the Canadian "Soo" one of the largest flour mills on this continent, with a capacity of nearly 4,000 barrels per day. The output of the mill will be shipped direct to England by their own vessels.

The great strike among the steel workers in the United States has come to an end, and the men returned to work on Sept. 16. The strike affected about 60,000 hands. The terms of settlement seem to have been mainly in favor of the employers.

F. Buchanan, of Toronto, has made a proposition to the village of Streetsville in regard to the starting of a leather factory. He wants a cash bonus of $5,000, to be paid when the factory is in operation. He will employ a minimum of 60 hands. He will spend about $8,000 on the factory.

Work has been suspended on the West Kootenay Power & Light Company's big plant at Bonnington Falls, the present position of affairs at Rossland not warranting its continuance. A building is being constructed for storing 3,000 barrels of cement imported from England for the works.

A contract is under way for the construction of a three feet sewer between the new village of Tagona in Algoma and the mouth of the Hudson Bay Co.'s creek, at a cost of $80,000. The walls are concrete and brick. A powerful dredge is in use. The excavation will be a mile long.

The Renfrew Power Company have let the contract for the construction of a dam, flume and power house on the Bonnechere river to E. A. Cawsey, for the sum of about $15,000. The contract is to be completed by the end of December. The company expect to be ready to run their plant about February 1st, 1902.

Col. R. G. Leckie of Sudbury, managing director of the Orford Copper Company, has gone to New Caledonia. He expects that next year 30,000 tons of matte will be imported from Norway, where he has just been, and 100,000 tons from New Caledonia. At present the Orford Company is taking all the product of the Canadian Copper Company, which is reducing about 800 tons of ore a day and refining it at Sudbury.

Nelson is soon to have a $200,000 block of white Kootenay marble.

Sims & Burgess have commenced construction on gas works in Lindsay.

Tenders are asked for 12,000 yards of sheet asphalt paving at St. John, N.B.

The village of Wiarton is putting down 70,000 feet of granolithic sidewalk.

Alcohol is being successfully used as fuel on a locomotive in a brickyard in Prussia.

Tenders are asked for the wharves and buildings for the new steel works at Collingwood.

J. R. Booth has been fined $20 twice for allowing sawdust from his mill to empty into the Ottawa river. He has promised to erect a consumer.

The Pembroke Observer is agitating for a glass factory, and says suitable raw material abounds in the vicinity.

Oil has been struck at well No. 2, St. Joseph, N.B., at a depth of 183 feet. Two more wells will be bored at once.

It is estimated that this year's cement sidewalks in Hamilton will cost over $100,000. It is thought that 30 miles will be laid.

Port Colborne will lay down $15,000 worth of concrete sidewalks. Geo. Ross, C.E., of Welland, will be in charge of the work.

The Niagara Falls, N.Y., Gas Co. is laying seven miles of new mains to enable them to supply gas to the Canadian town of like name.

Work on the peat fuel factory at Rond Eau is so advanced that the company will commence manufacturing almost immediately.

The international bridge over Rainy River, between Beaver Mills and Beaudette, has been opened. It is on the line of the Canadian Northern Railway.

Beaverton Foundry and Machine Co. is the title of the new company which has taken over the Phoenix foundry in that village.

Before the introduction of water meters in Winnipeg, from 2,600,000 to 2,800,000 gallons a day were used, now the average is 1,200,000.

The breakwater at Port Colborne is being pushed forward. Nine cribs, 900 feet in all, have been sunk, and filling and backing is now going on.

Elevator B at Owen Sound is being converted into a monster corn mill by Chandler & Co., of Boston. Some 20 machines are being placed in position.

A Beaverton exchange states that a large part of the machinery to be built by the Peat Machinery Supply Co., of Toronto, will be manufactured in that village.

The North river, N.S., Lumber Co. announce that they will have a pulp mill under construction at St. Ann's within six months. The mill will employ over 200 hands.

Boeckh's brush works, Toronto, Cane's woodenware factory, Newmarket and the London brush factory, are to be amalgamated under the name of the United Factories.

A Russian professor has discovered a powerful explosive which is perfectly safe to handle, since explosion takes place only on ignition and after sulphuric acid has been poured on.

The Trades and Labor Congress in session at Brantford resolved to petition the provincial legislatures to compel municipalities, where waterworks and sewerage systems exist, to appoint competent plumbing inspectors.

W. T. Jennings, C.E., of Toronto, has examined and is to report on the question of a larger water supply for Sydney, C.B. In the meantime a number of extensions will be made in the waterworks.

A. W. Campbell, deputy minister of Public Works, has laid out a plan for main roads in the Temiscamingue district. There will be four main roads, totalling 50 miles, from which the settlers will build branches.

Silverton, B.C., is putting in a system of waterworks.

Another natural gas well has been struck at Collingwood, with a pressure of 25 lbs. per inch.

The ratepayers of Thorold have authorized an expenditure of $30,000 on permanent sidewalks.

Mr. Copp, of Copp Bros., Hamilton, will start a foundry at Fort William. His son will be manager.

Stratford ratepayers have passed a by-law to borrow $20,000 for completing sewage disposal works.

F. H. Clergue, of Sault Ste. Marie, is spending at the rate of about $1,000,000 a month in wages, contracts, etc.

Three new shingle mills at Vancouver and one at New Westminster are in course of construction, owing to increased demand.

The number of places in Ontario where beet sugar factories are talked of is legion, but most of them are as yet castles in the air.

Southampton, Ont., is about to have a system of waterworks at a cost of $16,000. It will also aid a chair factory about to be established.

The Buffalo Courier gives currency to a rumor that the American Steel Corporation is buying up all the Bessemer pig iron that is in sight.

The American Steel and Wire Co. is about to establish a branch in Canada. The probable location will be either Toronto, Hamilton or Brantford.

During the present year to date, J. C. Wilson & Co., Glenora, Ont., report the sale of 22 Little Giant turbines in Great Britain and other European countries.

Two new buildings for the Science Department of Queen's University, Kingston, are being erected. A new building for the mining school is to cost $90,000, besides equipment.

J. C. Wilson & Co., Glenora, Ont., have just closed a contract with the town of Iroquois, to build a double 44-inch Little Giant turbine to increase the capacity of their electric light and water plant.

The Albion Iron Works Co., Ltd., of Victoria, B.C., have arranged to operate the foundry and machine shop of the old British Columbia Iron Works, which have been closed for over three years.

The Toronto Foundry Co. is asking for tenders for a new building, 150 feet square in rear of the Mercer Reformatory. The building is to be largely of steel, and will be specially lighted and ventilated.

Members of the Ontario Cabinet, who have been visiting Rat Portage, have promised that the Government will grant aid towards a permanent bridge to replace the floating one between Rat Portage and Norman.

Two Little Giant water wheels, a 21-inch and 33-inch with the necessary gearing, shafting, etc., are being supplied by J. C. Wilson & Co., Glenora, Ont., for the power plant now being constructed by the town of Hanover.

A 33-inch horizontal Little Giant turbine is being installed in the pulp mill being erected by Geo. Sisson at Bourg Louis, Que. This wheel is being placed by J. C. Wilson & Co., Glenora, Ont., and contains their latest improvements.

That the Little Giant turbine as manufactured by J. C. Wilson & Co., Glenora, Ont., is in good favor with trans-Atlantic owners of water powers is attested by their rapidly growing trade over there. No less than three wheels were recently ordered in one day.

The Mormon colony in Southern Alberta is likely to have a sugar refinery in the near future. Tests made of the beets grown there show 25 per cent more saccharine matter than in the beets supplied to the refinery at Salt Lake City. Capitalists from Utah have taken the matter up.

Tenders are being asked for a steel bridge over Victoria Arm at Point Ellice, Victoria, B.C., where a serious accident took place several years ago, since which there has been only a temporary structure. The bridge will be 600 feet long with 24 foot roadway, to accommodate highway and heavy tramway traffic.

A sale of timber berths took place at the Parliament Buildings, Toronto, Sept. 17th. The prices realized averaged $2,090 per square mile, and the total amounted to $832,750.

A by-law has been passed at Smith's Falls, by a vote of 580 to 24, giving the Frost & Wood Co. a bonus of $20,000 and the right of way for a railway siding to their works, which they will at once proceed to enlarge.

An elevator of a million bushel capacity is to be erected at Point Edward. Botsford & Jenks, of Port Huron, have the contract. Work will be pushed this fall if the Dominion Government agrees to do some necessary dredging.

It is reported that a syndicate of Michigan millionaires, operating the Scott lumber and shingle mills at New Westminster, will commence the construction of a big saw mill and shingle mill on Burrard Inlet, Vancouver, with a capacity of 150,000 feet.

Gamble & Waddell, civil engineers, have selected a site for a bridge at Chimney Creek to afford access to the Chilcotin country. The engineers decided that a suspension bridge about 300 feet in length will be necessary, and that the cost of the structure will be about $40,000.

A number of applications have been filed with the Government for assistance in carrying out drainage works under the Ontario act. One of the most important is that on Pelee Island, Lake Erie, where considerable diking will have to be done, after which the water will be pumped out.

Scarcity of "white gold," known in chemistry and commerce as platinum, is causing concern in the medical, electrical and photographic circles. Five years ago it was worth $5 an ounce, now it is quoted at $36, nearly twice as high as gold. The increased demand and the flooding of the mines in the Transvaal are the alleged causes.

Clarke Bros., of New York and Toronto, have bought from the Quebec Government for $15,000 a large water power on the Ste. Marguerite river and on the Lower St. Lawrence, where they intend to erect a pulp mill of a capacity of 50 to 100 tons per day. They propose to reach tide water by a railway to Seven Islands, where wharves will be built.

Another vast industrial combination is said to be under way for the purpose of controlling the world's supply of window glass. The American Window Glass Co., of Pittsburg, practically controls the window glass business of the United States, and the only factories in Europe that amount to anything are in Belgium.

The McClary Manufacturing Co., London, have installed an immense drawing machine for the manufacture of enameled ware. It was manufactured at Goppinger, Germany, the original home of enameled ware, and weighs 90,000 lbs. It is used for shaping the steel blanks into all kinds of ware, and will make anything from a cup to the largest vessel. It is said to be the largest machine of the kind in America.

Hon. Mr. Fielding, in an interview at Halifax, agreed with his colleague, Hon. Mr. Tarte, in the importance of encouraging iron shipbuilding in Canada, and referred with satisfaction to the shipyards now in operation at New Glasgow, N.S., Sorel, Toronto and Collingwood. He expressed a hope that a fast Atlantic service would soon become a reality.

Sixty students of McGill University, Montreal, from the Civil Engineering and Mining Departments, have gone to Carignan for a month, to engage in practical field work, under Prof. McLeod. Each student makes surveys and plans for railway and water power purposes, as well as land and topographical surveys. The work done is counted as part of the year's work, and the marks awarded go toward the total for the session.

The Dominion Iron and Steel Company has already secured a foothold in the United States market. Three cargoes of pig iron, making in all two thousand tons, have been shipped from Sydney, two to Boston and one to Hoboken, N.J. It is understood that the iron has proved very satisfactory and that other cargoes will shortly be shipped. Notwithstanding the high duty imposed, Sydney pig iron can be landed at Boston at a lower figure than iron from Pennsylvania.

Two hundred machinists at the Kingston Locomotive Works went on strike because a union man was discharged for refusing to work overtime in order to overtake work in which he had got behind during his holidays. The works will close rather than yield.

The business of the J. W. Mann Manufacturing Co., at Brockville, has been sold to a party of capitalists represented by Geo. Hildebrandt, of Toronto, for $100,000. The Mann Company is one of the oldest agricultural implement concerns in Canada.

F. H. Clergue and eastern capitalists are forming a company for the manufacture from steel of seamless lap welded and butt welded tubes, up to the diameter of 10 inches. The buildings of the company will be 500 x 1,200 feet, and constructed entirely of steel. The machinery is now on the way from England. The concern will employ between 500 and 600 men. H. G. Waddie, of Liverpool, will be superintendent.

One of the largest wood cutting contracts ever made has just been entered into by the Clergue Syndicate with H. K. McLean. It is for the cutting of 300 cords of hardwood daily for a year, to be used in the carbonization plant of the big steel works now being built. The charcoal iron plant will be the largest in the world, having a capacity of 600 tons of manufactured product daily.

Among recent shipments of Little Giant turbines reported by J. C. Wilson & Co., Glenora, Ont., are a 24-inch horizontal type, to T. H. McMullen, Truro, N.S.; an 18-inch vertical and gears, to H. Hortop, Eden Mills; a 21-inch vertical to Fred. Heimbecker, Hanover; a 24-inch vertical, to P. E. Roy, Emileville, Que.; a 16-inch vertical to E. K. Weber, Strasbourg, Ont. Their machine cut gears still maintain their reputation for excellence, as is attested by the numerous orders being placed for this class of work.

Crane Co., New York, a branch of Crane Co., Chicago, manufacturers of valves, fittings, pipe, etc., have added to its already large quarters a plant for the cutting, threading and flanging of large and small pipe and for pipe bending. It is located at 497 to 505 Cherry street. The building is 125 ft. by 100 ft., the main shop being 110 ft. by 63 ft., and devoted to the cutting, threading and flanging of large pipe. The rear shop is devoted to the handling of small pipe, and to pipe bending. A paved driveway runs through the building at one end from the pipe storage yard to Cherry street. The pipe is brought from the yard to the machine on trolleys with air lifts, and when ready, is loaded into the trucks in the same way. There are thirteen pipe machines in the main shop, and in addition to these, there are machines for screwing up flanges of all sizes and facing lathes for refacing flanges after they are screwed on.

Electric Flashes.

The village of Marmora is to have electric street lamps.

The Sarnia Gas and Electric Light Co. has obtained the franchise for supplying Point Edward with gas and electric light.

Berlin has defeated, by 14 majority, a by-law to grant $20,000 for the completion of the Berlin, Preston and Hamilton electric railway.

The yearly earnings of the Toronto Railway Co. have now passed the $1,500,000 mark. The company has increased its dividend to 5 per cent.

The Canadian General Electric Co. has arranged with the Government to develop power at Nassau Mills for use at its Peterborough works. Nassau Mills is on the canal about three miles above the town.

A telegraph cable has been laid between Chateau Bay on the Labrador coast, and Belle Isle. The Marconi system of wireless telegraphy is also to be installed, posts 150 feet long being used.

Port Arthur has a municipal trolley system.

Sunlight Soap Co. are installing a slow speed motor for direct connection. It was manufactured by the Jones & Moore Electric Co.

Thorold, which has been in darkness for some time, will soon have its streets lighted again.

The Jones & Moore Electric Co. are building two 20 k.w. 250 volt direct current generators for J. Schnitzler, with switch-board and instruments complete.

The by-law to take stock to the amount of $50,000 in the Woodstock-Youngsville radial railway was carried in Embro by 60 majority, but was rejected in West Zorra by 81.

The Jones & Moore Electric Co. have received an order for one of their 20 k.w. multipolar generators, and a 25 horse-power, 500 volt electric motor from the Ontario Chemical Co.

The project is revived for crossing Victoria Bridge, Montreal, with the electric cars and spreading out with a network of lines through the municipalities on the south shore of the St. Lawrence.

The Toronto Railway Co. having adopted the Twentieth Century fender, is having the patterns made at their shops for the manufacture of the fender, which willl be placed on all their cars as rapidly as possible.

Thorold owns its electric light plant, which supplies twenty-five 1,200 candle power arc lamps for the streets, and over 500 incandescent lights to customers at seven cents a week per 16 candle power light. The system is being extended so that 2,000 lights can be supplied.

The streets of Portage la Prairie have been in darkness for over five months, on account of differences between the town council and the electric light company. A new contract has now been made for three years. The lamps are to be of 1,800 candle power.

A tragic ending recently came to a suit at St. John, N.B., against the Street Railway Co. of that city. Dr. J. H. Morrison, an eminent oculist and a candidate for parliament in King's county at the time, was injured two years ago, and has been an invalid ever since. He sued the railway for $60,000, and after long delay the case came to trial. The plaintiff was in the witness box two days, and finally collapsed from nervous strain, and died after a few hours.

A question has arisen in the Cornwall town council as to the use of water-power or electricity for pumping the town's water supply. The Freeholder advocates the latter, and refers to the possibility of purchasing the Stormont Electric Light and Power Co.'s system, whose franchise expires next April, and using it for both water and electric light purposes. An alternative presents itself in obtaining power from the St. Lawrence Power Co., which is developing great power at Mille Roches.

Several new electrical appliances were exhibited and explained by Prof. W. J. Clarke, of New York, at a lecture in Massey Hall, Toronto, a few days ago. Among these was the auokophone, by which the deaf can be made to hear. A number of deaf mutes put the apparatus to the test, and established its efficacy. A portrait of the Duke of Cornwall and York was received by telegraph from Montreal. Wireless telegraphy, the X-rays, moving pictures, and other electrical phenomena were also shown. Some experiments with liquid air could not be made, as the air could not be procured.

Almonte undertook recently to acquire the electric light works, which had hitherto belonged to a company, which was said to be making 18 per cent. on its investment. The company asked $22,000 for their plant, finally coming down to $17,000. The matter was referred to arbitration, the arbitrators being Judge Liddell, of Cornwall; Judge McTavish, of Ottawa, and J. H. Burritt, barrister, of Pembroke. They awarded the company $14,750 for their plant, and $1,200 on account of expenses of arbitration. The town pays its own costs, the fees of the arbitrators, some $600, and the stenographers' fees, $180.

A movement is on foot to connect Rat Portage, Keewatin and Norman by electric railway.

Port Arthur is to have electric power from the Current river, having passed a by-law to borrow $30,000 for the purpose.

The Jones & Moore Electric Co. are installing an electric light plant for Sylvester Bros., of Lindsay, Ont., to light up their works.

The Everett-Moore syndicate, of Cleveland and Detroit, are now virtual owners of the Windsor and Walkerville electric railway as well as the projected line to Amherstburg.

The Belleville street railway, two miles long, has been sold under a mortgage. It was bought by Mayor Graham for $6,750. He is understood to represent Toronto people.

Telephone communication now exists between the hospice of St. Bernard, Switzerland, and shelters all along the climb. Wayfarers can telephone for help and a man and dog are sent to the rescue.

The British Columbia Electric Railway Co. and the Vancouver Power Co. are about to expend $600,000 in developing the water power of the Coquitlam. It is expected that 5,000 h.p. will be generated.

The Dominion Iron and Steel Co. are putting in an electric lighting plant to carry on work night and day at their dolomite quarries, Marble Mountain, where 1,200 tons are being taken out per day.

The Von Echa Company are negotiating with Brantford for a franchise for a line connecting Galt, Brantford and St. George, and Paris people want them to continue the line from St. George to Paris.

The Parry Sound Lumber Co. has had two or three electric carriers built to convey lumber from the tramways in the new yard to the rails of vessels in loading. The lumber is carried by live rollers operated by electricity.

Peter Lyall & Sons, Montreal, have the contract for the new substation being built by the Royal Electric Co., for receiving current from Chambly. The building will be 122 by 118, and 50 feet high, and will be very complete.

Through telegraphic communication has been established with Dawson, the wire having been connected, and the first messages sent through on Sept. 24th. There are 47 stations, 40 miles apart, and a refuge house half way between.

It is pretty well understood that the Toronto Railway Co. is about to purchase the Metropolitan and other suburban lines, though those concerned will not speak about it. The capital stock is to be increased $1,000,000 for the purpose.

An interesting re-union took place recently in Montreal of old time telegraphers, some of whom came a long distance to be present. Mr. McKay, of St. John's, Nfld., celebrated, while at the gathering, his 51st anniversary as an operator.

Another great iron trust has been formed, the three large producing firms of Bilbao, Spain, having agreed to amalgamate on the basis of the United States Steel Corporation, with a capital of 75,000,000 pesetas, and an annual output of half a million tons.

The secretary of the Canadian Electrical Association has received through A. A. Dion, past president, a cheque for $100, sent as a refund of two-thirds of the amount voted by the association for entertainment purposes in connection with the annual convention held in Ottawa last June. This generosity will be appreciated by the association.

A judgment recently rendered by Justice Andrews in the Superior Court of Quebec, in an action brought by the Quebec Railway, Light and Power Co., against the Jacques Cartier Water Power Co., is of the greatest importance to electrical companies, as well as to municipalities and users of electric light and power. The plaintiffs claimed damage to their property and business from the defendants' poles and wires, and asked the courts to compel their removal. The judgment was in favor of the plaintiffs, and is based on the principle that the plaintiffs having been first established, the second company is not entitled to cross their wires at any place or height. Such a decision is so far-reaching in its effects, and would cause such endless difficulty, that an appeal will be made to a higher court.

The end is not yet of the contract entered into between the Montreal City Council and the Royal Electric Co., for the lighting of the city. The tender of the Royal was $95 per lamp, per year, while the St. Lawrence Power Co. offered to furnish the lighting for $54.75 per light. The council determined, on a vote of 18 to 15, to give the contract to the Royal at $60. The Standard Electric Light Co. served a protest against the contract, and one of the aldermen stated that he had been offered a bribe to vote for the Royal contract, and asked for a committee of enquiry. An injunction has also been applied for. It is held that the contract is illegal, as the city charter makes it imperative that for contracts exceeding $500, tenders must be called for by public advertisement. As all the tenders were rejected, and the contract offered to the Royal, when no tenders were before it, the action of the council appears to be illegal.

Basing his opinion on what he recently witnessed in California, Dr. Riordan, of Toronto, states that there should be no difficulty in conveying electric power from Niagara Falls to Toronto. Electricity for heat, light and power is brought to Los Angeles from a distance of 125 miles, with a loss of only 5 per cent., and to Pasadena, 10 miles further. The electric companies there have met with keen opposition from the fuel oil interests. Fuel oil, or crude petroleum, has superseded coal for many industrial purposes, and is furnished very cheaply. Where coal is sold at $7 to $9 per ton, fuel oil can be produced for about 40 cents per barrel. Two barrels of oil for fuel purposes are equivalent to a ton of coal. The transmission plant, Dr. Riordan says, is almost perfect. One of the peculiarities is the high voltage at which the current is sent. The company is about to instal another power plant 10 miles further up the mountain canyon, which will give them about 800 feet head. The system was designed by Mr. Edison and Mr. Ensign.

With reference to the transmission of electrical power from Niagara Falls to Toronto, and the effect of a break down of the plant, an instance is furnished from Buffalo, which gets its electricity from the Falls. When the American Institute of Electrical Engineers met there, that body had been invited to the Exhibition to see the illuminations, and on that very night the whole business gave out, through an accident on the line, and there was, of course, no illumination.

The electric car, "Duchess of Cornwall and York," provided by the Ottawa Electric Railway Company for the use of their Royal Highnesses, the Duke and Duchess of Cornwall and York, is a very fine creation. It is fifty feet in length, with straight sides, vestibuled at both ends, and full monitor roof of the Pullman pattern. The color is Pullman standard, with the British coat-of-arms in gold on both front and rear. The interior is finished in antique polished oak, the ceiling being covered with three-ply bird's eye maple veneer and decorated. There are four large British plate mirrors set in frames, two at either end of the car. All the trimmings, such at hat racks, hooks, etc., are of solid bronze. The window curtains are of the latest design, and are very ornamental. The car is brilliantly illuminated by five clusters of incandescent electric lamps, twenty-one in all. The floor is covered with a rich, royal blue, velvet carpet. The car contains fourteen easy chairs, beautifully upholstered in olive green plush. The trucks are double, and of the swing motion pattern, with graduated springs. The electric equipment consists of four Westinghouse fifty horse-power motors. A speed of fifty miles per hour is attainable. The car was built by the Ottawa Car Manufacturing Co.

—In order to relieve the works at Canal and Judd Streets of some of the heavy work, Crane Co. has this summer erected at its works at Jefferson, Van Buren and Despiaines Streets, Chicago, a foundry which is to be devoted exclusively to very heavy work, i.e., flanged fittings and large valves. It is a one story brick building with a slate roof, and is equipped with two cupolas, an electric traveling crane, and every other modern convenience. This new foundry will increase the company's capacity for very heavy work about 50 per cent., and it is expected to be in operation in about 30 days.

Marine News.

A new steamship, the Ionian, has been launched at Belfast for the Allan line. She is of 8,070 tons.

The steamer Midland City recently arrived at Chicago from Manchester direct. She will remain on the lakes.

The steamer John Long, in service on the Georgian Bay, was recently burned at Meldrum Bay, Manitoulin Island.

The dredge being built at Beaverton for the Lake Simcoe section of the Trent Valley Canal is nearing completion. The engine is 70-h.p.

John Kennedy, the Montreal harbor engineer, is engaged in the preparation of the plans for the Imperial Dry Dock company's dock at St. John.

Mr. Connolly's big dredge International will shortly complete its work at Port Mulgrave, and then go to St. John, N.B., to do some work in the harbor.

The Northern Pacific railway will build two immense steamships for the Pacific and China trade of 28,000 tons, or three times the capacity of an average ocean freighter.

The Elder-Dempster line has secured the steamer Warri, just built at Newcastle. She is 325 feet long, 45 feet beam and 22 feet deep, and has a large capacity on a light draft.

It is reported that a new company is being formed with a capital of $150,000, to build a new side-wheel steamer and engage in the summer resort business on Lake Simcoe.

John Findlay, a Hamilton hotel-keeper, is suing the Hamilton Steamboat Co. for $200 damages, for injuries sustained on the Macassa on July 24th, by falling into an unguarded hole.

Mr. Whyte, of the C.P.R., who recently made a trip round the world, says the trip was made for the purpose of establishing a line of steamers from the Pacific coast to Vladivostock.

An Ottawa despatch says that arrangements are well under way for commencing work on the French River navigation scheme, recently investigated by the Minister of Public Works, personally, in a canoe.

President Shaughnessy, of the C.P.R., has been elected a member of the first directorate of the Reid-Newfoundland Co. The company has a capital of $25,000,000, and will develop the railroads, steamships and resources of the island.

When a tug assists another tug to tow a raft, the work is performed on the raft and not on the assisted tug, and the claim for services is not a lien on the assisted tug. This is the effect of a decision rendered in the United States District Court at Duluth.

A scow loaded with electrical machinery for the Orillia power scheme sank on Sparrow Lake during a recent storm. The boxes were recovered, as the packing was sufficient to float them, but the scow with a lot of cement and tools is still on the bottom.

Contracts have been let for the improvement of Hay Lake channel in St. Mary's river, to cost about $500,000. The work will occupy two years, and will result in a channel wide enough to prevent a recurrence of the Douglas-Houghton blockade of two years ago.

An attempt was lately made to raise the Rathbun Co.'s steam punt, Flying Dutchman, sunk in the Fenelon river in 65 feet of water. The grappling hooks caught the bow, but when the men began to lift on the winch the timbers parted and the craft settled back. The attempt will probably be abandoned.

It is expected that there will be a new steel steamer on the St. John river next season, to make daily trips between St. John and Gagetown. She will be of light draft and speedy, and specially fitted up for passenger business. She will be 110 feet long, and built after the style of the Prince Rupert of the D.A.R.

A new Atlantic steamship company has been formed at New York.

The Peary arctic exploring steamer Erik has returned to Sydney with all on board well.

The steam barge City of Cleveland has been wrecked on Perseverance Island, with a load of coal.

Capt. Cates and W. Haywood, of Vancouver, B.C., are arranging to build a new 15-knot steamer, 120 feet long, for the coast trade.

The department of marine and fisheries is calling for tenders for a new lighthouse on Brockton Point, Vancouver, British Columbia.

The White Pass and Yukon railway will probably place a fleet of freight steamers on the river to run to Dawson in connection with their road.

M. Beatty & Sons, of Welland, are adding to their shipyard a new building, which will be equipped with additional plant and a gas engine.

Capt. Bernier, the Canadian navigator who proposes to try and reach the North Pole, is appealing for subscriptions, either in money or kind, to assist him in fitting out his expedition.

It has been proved that the fog signal at Cape Race cannot be heard within certain zones, in certain atmospheric conditions, though distinctly audible further off. This is a new danger to mariners.

Poupore & Fraser are suing the Crown for some $177,000 for extra work and loss of profits in their contract for widening the Rapide Plat division of the St. Lawrence canals, occasioned by a change in the works by the Government engineer.

The United States steamer, Hartford, recently ran into and seriously damaged a bridge on the Welland canal. She was held for the damage, but managed to escape and went up Lake Erie, pursued by a Canadian Government steamer, which failed to overtake her.

The British torpedo boat destroyer Cobra has foundered in the North Sea, the result of an explosion. She was a turbine-engined vessel, and was undergoing a boiler test after leaving the yard of her builders. She was the fastest vessel in the world, having made 43½ miles an hour.

The steam barge Saturn was lost, with a cargo of coal, on the Georgian Bay, in the gale of September 17. She formerly ran as a passenger steamer between Collingwood and the Sault, but was sunk off Clapperton Island, and subsequently raised and refitted in Collingwood dry dock.

It is understood that three of the old boats of the Richelieu & Ontario Navigation Company, the Island Queen, Caspian and River du Loup, have been disposed of, and that next season will witness the launching of two fast modern boats which the company has contracted for. They will be of the most modern type of construction and equipment.

The steel barge Hamilton, built by the Hamilton Bridge Co. for the Montreal Transportation Co., has been launched. She is 206 ft. long, 41 ft. beam, 14 6 ft. draft, and there are 340 tons of steel in her. She has a rock elm bottom, and will carry 185,000 bushels of wheat. The same company has ordered two more barges, to carry over 200,000 bushels each.

The suction dredge, built for the Dominion Government by the Polson Co., Toronto, and said to be the largest hydraulic suction dredge in the world, was launched on the 2nd of September. Hon. Mr. Tarte, after whom it is named, was present. He made a speech pleading for more shipbuilding in Canada, to encourage which he had given the order for this dredge.

A new lightship on the west coast of Scotland has some novel features. It is built of steel and is divided into three water-tight compartments, the middle one of which contains two gas holders. The lantern is placed on a mast 25 feet high. There is a large bell, which in addition to the usual clapper, has a special one, which is operated by the passage of the gas from the holder to the burner. The tanks hold gas enough for several months and the apparatus is entirely automatic, so that no crew is required

Though the old-fashioned full-rigged ship has passed, sailing vessels are not likely to become obsolete. Of late the shipbuilders of the United States have been constructing huge seven-masted schooners, of enormous freight-carrying capacity, intended for long voyages. The advantages claimed are that they do not require so many men to work them, are cheaper than steam vessels to navigate, are easily handled and can be run at a greater profit.

The passenger steamer Greyhound, of the White Star Line, has made her last trip as a passenger boat between Port Huron and Detroit, and will be dismantled. It is probable the hull will be converted into a lumber barge. The Greyhound is about the last of the fleet of old style sidewheel boats that were famous on the Upper Lakes for their speed and fine equipment a quarter of a century ago. She was built at Manitowic in 1867.

The year 1901 will show a larger number of steel propeller wheels made up than for any two previous years. The Marine Iron Works, of Chicago, report that they have more than doubled any previous year's sales on these steel wheels with three months yet to hear from. The composition used by this firm is an open hearth homogeneous steel, and is exceedingly tough and ductile. The higher first cost when compared with the cast iron wheels is surely covered, especially where boats are operating at times on somewhat shallow water.

A scheme for bringing a large part of the lake traffic to Montreal by means of canal steamers is mooted. Captain A. B. Wolvin, of Detroit; W. Z. Brown, president of the American Ship-building Company, of Chicago; J. H. Hoyt, of Cleveland; Edward Smith, of Buffalo, and the Messrs. Wallace, of Cleveland, who are largely interested in the lake shipping business, are the promoters. They propose to bring the lake traffic to Port Colborne, and then trans-ship it to special steamers through the canal which would convey it to Montreal. There would be a fleet of ten steamers, representing an outlay of a million and a half dollars, each steamer to have a capacity of some seventy thousand bushels. It is proposed that each steamer should make 21 trips to Montreal during the season. Terminal facilities would have to be provided at Montreal.

Mining Matters.

Last year the United States purchased $14,135,000 worth of quartz from Canada.

Belleville Board of Trade are asking the Government for a larger grant to the Provincial Assay office.

The Le Roi mine at Rossland, after a time of inactivity arising from labor difficulties, has resumed work.

It is stated that Geo. McIlraith, of Darling township, who owns a lot where hematite prevails, has been offered $30,000 for his farm.

The directors of the New Brunswick Coal and Railway Co. have decided to take immediate steps for the opening and development of the coal fields.

The Regina Gold Mine on the Lake of the Woods is now being worked by the Black Eagle Mining Co., of London, who have erected a thirty-stamp mill.

Mining in Hastings county is very active. The owners of the Belmont Cordova and other gold mines are adding to their plant. The corundum industry is also looking up.

New and important discoveries of iron are reported from east of La[illegible] Nepigon. The ore is hematite of low grade, but 40 per cent. purity. The Clergue syndicate is likely to work them.

Last month Alex. McDonald, a machine miner, at Dominion, C.B., cut 3,245 tons of coal. This is the largest ever produced by one man. His earnings for that month would amount to about $300.

A discovery of rich cinnibar ore is reported from Revelstoke.

All the coal fields of the Souris district, Manitoba, have been amalgamated under one management.

The Inter-Colonial Graphite Co. has been organized under the Maine laws to work a deposit of graphite in Cape Breton. The president is John S. Honeycombe, and secretary-treasurer is W. Ramsay Dodge. The head office is in Boston; capital, $125,000.

No. 2 well at Hepworth has developed a great flow of gas. The combined flow from Nos. 1 and 2 is estimated at 800,000 cubic feet in 24 hours. It is in contemplation to pipe the gas to Wiarton and use it as fuel for various industries, including the new beet sugar factory.

Ulysse Chopin, civil and mining engineer of Montreal, has just returned from Lake Temiscaming, where he has spent his holidays. Mr. Chopin has found a large deposit of copper (chalcopyrite variety), and a fine specimen of iron ore. He has also met with a very fine red granite of about two square miles area, and situated about a mile from a proposed railway.

A demand has sprung up for molybdenite, and enquiries have been made at the Ontario Bureau of Mines, by a London, Eng., firm, as to our ability to supply it. Its great value can be appreciated when it is known that its selling price is $600 a ton. As an electrode it ranks very high, and is a good substitute for platinum in electrical work.

The Mining Record of Stellarton, N.S., asserts that the Dominion Coal Co. is about to test the feasibility of sending coal to Mediterranean ports, where there is a demand for such coal as Nova Scotia has, as a gas producer. France produces some 30,000,000 tons of coal, but is forced to import 12,000,000 more. The scheme is not a new one, but home demand has stood in the way of its elaboration. It is probable several trial cargoes will be sent after the close of St. Lawrence navigation.

There are eight or ten applications in for the vacant chair of mineralogy in Toronto University. Among the applicants are Prof. Winchell, a well-known professor and geologist, who has filled various positions in the United States; Dr. W. G. Miller, one of the university's graduates, who has been in the School of Mines, Kingston, for some time; Prof. Farrington of the United States, Dr. Ami of the Province of Quebec, Prof. Baggs of the United States and Dr. Willmott. President London, who has been in France and Germany, says great attention is being paid in the seats of learning in those countries to geology, mineralogy, metallurgy, etc.

Railway Matters.

It is said the C.P.R., which has purchased the K. & P.R., will build a large hotel in Kingston.

The long continued strike of the trackmen on the C.P.R. is over, and the men are all at work again.

A new signal for use at night is to be introduced on the I.C.R. It is a fuse stuck in the track and burns about ten minutes.

Ald. Lamb of Toronto has received a letter from the Standard Car Lightning Company of Chicago, offering to finance a radial railway scheme for the city.

A survey has been commenced of the Nanaimo-Alberni, B.C., railway route. It will follow the northwest fork of the Nanaimo river to its source, and thence seek a pass to Alberni.

It is stated that the engineers of the Great Northern railway have decided to report in favor of equipping the entire Cascade, B.C., division of that road with electricity. The section includes the Cascade tunnel.

Eighteen new engines have been placed on the Western division of the C.P.R., and eighteen more are coming to engage in the extra work of hauling the big crop to the Fort William elevators. There are now 270 engines on the western division.

It is reported that the C.P.R. is about to take over the Bay of Quinte railway.

Work on the railway from Point Tupper to St. Peters is being pushed; 200 men are now at work.

Work has been commenced on the Ladner-Westminster trunk road, a provincial government undertaking.

The Shore railway from St. John to St. Stephen, N.B., has been sold by auction to Russell Sage of New York for $25,000.

The Trades and Labor Council at its meeting in Brantford affirmed its approval of Government ownership of railways.

The Grand Trunk railway is putting in a plant at Windsor whereby the tables at the slip docks will be operated by steam instead of by hand.

The Hawkesbury Bulletin says the section of the Inverness and Richmond railway between Hastings and that town is now almost ready for track laying.

A working arrangement has been completed between the Detroit and Lake Erie railway and the Pere Marquette. The steamer International will be used at Sarnia.

A train on the Michigan Central ran from St. Thomas to Windsor, 111 miles in 100 minutes. This is the fastest time ever made between those points. The engine was one of the new type, the Atlantic.

Harry Clendenning, of Ottawa, one of the most efficient and popular engineers running out of the capital, had charge of the engine drawing the royal train from Ottawa. His fireman was George Molen, Hintonburg.

The contract between the Nova Scotia Government and Mackenzie, Mann & Co. for the construction of a line of railway from Halifax to Barrington, with a branch from New Germany to Caledonia Corner, a total of about 200 miles, has been signed. The name of Mackenzie and Mann's company is the Halifax and Southwestern.

The Canadian Northern Railway is making extensive arrangements for handling its share of the wheat crop of the Northwest. Five new engines have arrived from Kingston and five from Philadelphia. The company has also purchased 500 new cars.

The Michigan Central has begun to run its new 75-mile per hour locomotives on the passenger service between St. Thomas and Niagara Falls. These engines are the largest that run to Niagara Falls over any road. Some of the bridges had to be strengthened before they could be used.

The Dominion Bridge Company has been awarded the contract for the bridge of the Chateauguay & Northern railway at Bout de l'Ile, and Loss & McCrea the construction of the road from the junction of the Great Northern near Joliette into Montreal. The firm of Smith & Abbott, who originally signed the contract, failed to proceed with the work.

The contract has been awarded for the bridge of the Vancouver and Lulu Island railway, which will be built across the North Arm, and will cost $20,000. The bridge will be 1,790 feet long. There will be four spans of 80 feet, one span of 100 feet, and a steel swing measuring 150 feet over all. The swing will be built on a masonry pier, the other portions of the bridge will be of timber.

A local company has been formed, with a capital of $1,500,000, to build a railway from the site of the Quebec bridge at Cap Rouge along the river front to Quebec. This company is composed of Hon. John Sharples, president; Hon. S. N. Parent, Provincial Premier, and Mayor of Quebec; M. P. Davis, contractor; John Hearn, M.P.P. for Quebec West; V. Chateauvert, R. Larue, G. Lemoine, W. Price, etc.

A suitable location has been found for the first twenty miles of the proposed Ontario Government railway into the Temiscaming district. This section carries the line beyond the watershed, immediately north of Lake Nipissing, and it is gratifying to know that the most difficult section of the line has been found quite feasible, and will have lighter gradients than was expected. The line traverses a fine hardwood section of country, with good clay land. It is expected the line to the head of Lake Temiscaming, 100 miles, will be located this season.

The Bruce Mines and Algoma railway has organized, electing the following officers: President, John McKay, Sault Ste. Marie, Ont.; vice-president, Sol. Skall, Cleveland; general manager, Arthur S. Burrows, Bruce Mines; treasurer, Herman Wile, Buffalo; secretary, I. C. Holden, the Soo., Mich. The contract for track construction was awarded to Birmingham & McMartin. The road will extend from Bruce Mines to Rock Lake.

The consolidation of the Ottawa, Northern and Western, the Pontiac and Pacific Junction and the Hull electric railway, including the inter-provincial bridge at Ottawa, involving $5,000,000, is one of the largest and most important railway deals which has taken place in Canada for some time. The three railways and the bridge will in future be under one management under the name of the Ottawa, Northern and Western Railway Company. Montreal capitalists are in the transaction, including S. H. Ewing, A. F. Gault, Samuel Finley and Hanson Brothers.

The Royal train of nine cars, built by the C.P.R. for the use of the Duke of Cornwall and York and suite is perhaps the handsomest train ever turned out on this continent. Two of the cars, the York and the Cornwall, are intended for the use of the Royal couple. The exterior of the cars is mahogany, the interior is fitted with rare woods and the most sumptuous fittings. Another car, the Canada, is for the occupancy of the immediate suite. Other cars named Australia, India and South Africa are more like ordinary sleepers, but more sumptuously fitted. The dining car, Sandringham, and two supply cars complete the train.

The first annual meeting of the Kootenay Central Railway Co. was held at Fort Steele on Sept. 2. The following were elected directors: R. L. T. Galbraith, J. A. Harvey, Jas. T. Laidlaw, A. C. Nelson, Dr. J. H. King and Dr. Hugh Watt. At a subsequent meeting the following officers were elected: President, Dr. Hugh Watt; vice-president, R. L. T. Galbraith; secretary, James T. Laidlaw; treasurer, A. C. Nelson; solicitor, J. A. Harvey. Taking Fort Steele as a radiating point, the first section of the road will be carried through that town to the Crow's Nest railway line to the south, the second will make the famous mines of the Windermere district its primary objective point, thence onward to Golden. Branches will run east and west connecting the capital of the district with the upper Wild Horse and Bull River region, with the St. Mary's Valley, Kimberley, Skookum Chuck and Tracey Creek.

Personal.

Pierre-Marie Alphonse Genest, P.L.S., died at Quebec, September 13.

Arthur Drysdale has been appointed commissioner of mines for Nova Scotia.

H. M. Perry, of Chicago, has been appointed master car builder of the Algoma Central railway.

H. Beauchemin, manager of the South Shore railway, states that he will retain his position under its new regime.

Prof. Sharp, Cambridge University, has been appointed lecturer of applied mathematics in the Kingston School of Mines.

H. R. Lordly, C.E., has been appointed assistant engineer of the Quebec canals. Mr. Lordly succeeds Mr. Papineau, who has resigned.

John F. Taylor, of Taylor Bros., the well-known brick and paper manufacturers of Todmorden, near Toronto, died on the 11th of September.

George Munro, vice-president of the Wm. Hamilton Manufacturing Company, Peterboro, died suddenly on the 18th of September, aged 61.

A. J. Nelles, manager of the Hamilton, Grimsby & Beamsville electric railway, has resigned. Geo. Walker, head clerk, succeeds him, and Albert Orr, conductor, becomes head clerk.

W. H. Douglass, manager of the Montreal Park and Island railway, has resigned to accept the managership of the Akron, O., street railway. Mr. Kennedy, superintendent of the M.S.R. assumes the management.

Wm. Stitt, of the C.P.R., who recently received an appointment to go to Australia as general agent for the company, leaves to assume his duties about the middle of October.

J. J. Franklin, at one time connected with the Toronto street railway, afterwards with that of Montreal, then manager of an omnibus line in Paris, France, recently died at Toronto.

S. H. Whitehouse, a member of the executive of the Miners' Federation of Great Britain, is visiting America to study the coal mining methods of Cape Breton and the United States.

A. T. Genest, C.E., of the Trent canal, and R. A. Davy, C.E., of the Cornwall canal, have exchanged positions. G. P. Cairnie has joined the staff of engineers on the Trent works.

The chief engineer of the department of militia will make his annual inspection on the following dates: Quebec, Oct. 13; Montreal, Oct. 16; Toronto, Oct. 19; London, Oct. 22; Kingston, Oct. 28.

James Ross, of Montreal, who has been prominently identified with the Dominion Coal Company, will in the future devote considerable attention also to the affairs of the Dominion Iron & Steel Company.

Thos McAvity, senior partner in the St. John firm of T. McAvity & Sons, one of the best known hardware firms in the provinces, is the new president of the Maritime Wholesale Hardware Association.

Alfred Baker, general manager of the county council tramways of London, England, and James H. Rider, chief electrical engineer of the system, are in Canada to study the system of electrical railways here.

Dr. Stansfield, of London, has been appointed to the new chair of Metallurgy in the faculty of Applied Science in McGill University. He is assistant to Sir William Robert Austin, the distinguished metallurgist.

Jas. Brougher, of Brantford, has been appointed inspector of machinery and agricultural implements imported into Canada, with a view to insuring the payment of duty on the proper valuation of such importations.

Mr. Joughins, mechanical superintendent of the Intercolonial railway, has resigned, and is succeeded by J. E. Muleield, lately of the Grand Trunk, who assumes the title of superintendent of motive power and machinery.

W. H. Lewis, who has for several years successfully represented the Atlantic Refining Company, of Toronto, throughout Western Ontario, has been appointed manager of the British Columbia branch, recently opened in Vancouver, B.C.

Edward Harrison, jr., who served his time with Jas. Balfour, architect, of Hamilton, has been home for a visit after thirteen years absence. He has just been appointed head of the engineering staff of the Santa Fe road, with headquarters at Topeka.

Mr. Klem, an importer and dealer in lighting goods, now looking after electric lighting patents in Australia, is on his first visit to Canada. His home is in Adelaide and he is a native Australian. His wife is a sister of Mrs. Bertram, wife of the well known manufacturer of Dundas.

Percy A. Gough, for the past nine years connected with the Carnegie Steel and Oliver Iron Mining Companies, and formerly assistant manager of the Minnesota Iron Co., has decided to locate permanently at Sault Ste. Marie. Mr. Gough will devote himself to the examination of and reporting upon mineral lands.

Santiago Sotomayor, of Chili, South America, is in Canada to examine into the utilization of water power for electric purposes. In Chili all of the electric railway power is developed by steam, although there is no lack of water power. Mr. Sotomayor is a railway contractor, and his general manager is Charles Symmes, formerly of Aylmer, Que.

Headley T. Richardson, late chief engineer of the steamship Empress of China, has been promoted to the position of superintendent engineer of the C.P.R. Company's steamships. He served in the old steamship Abyssinia, the first vessel to arrive in Vancouver in May, 1887, of the line of chartered steamers which were the pioneers of the Empress fleet.

E. J. Duchesnay, assistant general superintendent of the Pacific division of the Canadian Pacific railway, was killed at No. 11 tunnel, eleven miles west of North Bend. The timber beams in the tunnel had caught fire from a passing train and Mr. Duchesnay was superintending the work of putting out the fire when a large piece of rock fell and struck him on the head, killing him almost instantly. He was a clever railway man, and had been with the C.P.R. since 1881.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The Ontario branches of this association are preparing for the winter series of educational meetings. On the 4th Sept., Toronto No. 1 held a discussion on the differences in valve gears of automatic engines, in which Messrs. Wickens, Terry, Fox, Webb, Mooring, Moseley and Kuhlman took part.

On the evening of the 10th inst. the Hamilton branch will hold its first open meeting, when a paper on the Metric System will be read by J. Gill, of the Hamilton Collegiate Institute. This association is the first to take up the subject of the Metric System of Weights and Measures.

FIRES.

Good Roads Machinery Co.'s premises and Copp Bros'. foundry, Hamilton, damaged to extent of $8,000.——Lazier's grist and paper mills, Belleville, destroyed; loss about $35,000.——A number of tanks and warehouses at St. John's, Nfld., containing fish oil and fish.——C.P.R. coal dump at Outremont, containing 100,000 tons, damaged.——Berlin brush works, Waterloo, Ont., damaged to the extent of $2,500 or $3,000; stock of broom corn, etc., destroyed.——Grand Trunk elevator, Point Edward; loss, $100,000.——Steinhoff & Gordon's stave and hoop mill, Wallaceburg; has only been running three months, having been burnt out last April; loss, about $8,000.——G.T.R. station, Port Colborne; caused by explosion of a lamp.——Government steamer Minto, at Charlottetown, damaged to extent of several hundred dollars, chiefly in engine room.

NEW INCORPORATIONS.

The British Columbia Salvage Co., Limited; capital, $100,000.

The Duncans' Mining and Development Company, Limited; capital, $40,000.

The Chieftain Copper Mines of British Columbia, Limited; capital, $1,000,000.

Slocan-Republic Mining and Development Co., Limited; capital, $1,500,000.

The Grace Mining Co., Limited; capital, $1,000,000; head office, Ridgeway; J. H. Casler, S. C. Rogers, F. L. Dayton, W. H. Warhus and E. F. Zimmerman, of Buffalo.

The British-America Can Co., Limited; capital, $100,000; head office, Sarnia; W. S. Cumming, of Chicago; T. H. Cook, N. Gurd, W. T. Ferguson, of Sarnia; C. R. Morrison, of Port Huron.

The Superior Copper Co., Limited; capital, $1,500,000; head office, Sault Ste. Marie; J. P. Moran, F. R. Price, T. R. Harvey, Frank Perry, Geo. Kemp, and others of Sault Ste. Marie.

The Canfield Natural Gas Co., Limited; capital, $40,000; head office, Canfield; George Gowling, Wm. Gowling, Fred. Gowling, and others of Canfield, and J. F. Carmody, of Buffalo.

The Graham Company, Limited; capital, $250,000, head office, Belleville; R. J. Graham, F. P. Fredrick, H. W. Ackerman, Grace Graham, and others, of Belleville, to carry on a fruit canning and cold storage business.

LITERARY NOTES.

The Blue Book of American Shipping, published by the Marine Review Publishing Co., Cleveland, has now reached its sixth year, and is already a standard work. The edition for 1901, just out, is substantially bound in blue cloth, and makes a volume of 432 large pages. It is both a merchant marine and naval directory of the United States, and contains a good deal of marine information about Canada as well. The Blue Book gives a list of ships and their owners, with particulars as to tonnage, dimensions, etc., including steam and sailing vessels, lists of marine engineers and architects, the various associations connected with marine work, including yacht clubs, Government bureaus and officials, in fact it is hard to say what this comprehensive work does not give. From an interesting prefatory note we learn during the past year the United States Government awarded contracts for 14 war ships, aggregating 187,354 tons displacement and 297,120-h.p., at a cost, exclusive of armament, of $19,944,600. Altogether 61 warships are building for the United States Government. The merchant shipyards have also had a busy year. A novelty in sailing-ship construction has been the building of two six-masted schooners, the first vessels of this kind in the world. The number of vessels built during the year ended June 30, 1901, was 1,173 of 401,285 gross tons, compared with 1,058 of 305,677 gross tons for the previous fiscal year. The distribution was as follows: Atlantic and gulf coasts, 735 vessels of 190,948 tons; Great Lakes, 105 of 153,138 gross tons; Pacific coast, 151 of 46,105 gross tons; and western rivers, 182 of 11,094 gross tons. The vessels for foreign trade, however, have been few. With regard to United States vessels on the Canadian canals the publishers say: "A venture of far reaching influence attempted on the Great Lakes is worthy of record. It is the opening of the all-water route from the Great Lakes to Europe, via the Canadian canals along the St. Lawrence river. As a matter of historical record it may be noted that although a few small craft made the passage from the lakes to European ports years ago, the first vessel to utilize these enlarged Canadian canals as a commercial highway between the Great Lakes and Europe was the British steamer Monkshaven, when in October last it carried a cargo of steel from Conneaut on Lake Erie to Avonmouth, England. This vessel had been employed by the Clergue water power interests at Sault Ste. Marie and was returning to Great Britain for the winter when Mr. Carnegie seized the opportunity to send some steel abroad by that route. The vessel would have returned to England anyhow, but her trip constituted, nevertheless, the first use of the canals in a commercial sense. Since then the Northwestern Steamship Co., of Chicago, has opened a regular service on this route and its four steamships, built at Chicago last winter, have each made a trip abroad. The dimensions of the locks of the Canadian canals are 270 feet length by 45 feet width. They permit a draught of 14 ft. The vessels of the Northwestern Steamship Co. are 256 ft. long over all, 42 ft. beam and 26½ ft. depth of hold, which is regarded as the regulation Canadian canal size. The company expresses itself as satisfied with the results of its enterprise. The importance of this waterway, however, must not be either magnified nor minimized. It occupies a definite field, though a limited one, owing to the restriction in size. The completion of the canals, however, has permitted the lake ship builders to compete with the coast ship builders for the construction of some types of vessels for coastwise trade. Twelve vessels suited to transatlantic and seaboard trade, as well as lake service, were built on the lakes during the year ended with July, 1901, and the experiment of building, each in two parts, two steamers much larger than the canal locks is now being tried in Cleveland. These vessels will each be of about 7,000 tons capacity when put together at the seaboard, after being towed down the Canadian canals in sections."

Dr. Edwin Gilpin, inspector of mines of Nova Scotia, has prepared an instructive special report on "The Minerals of Nova Scotia." It contains a mineral map of the province with tables and accounts of the different mining districts. The book will be valuable to those studying the remarkable mineral and other resources of a province that is unique in geographical situation as well as potential wealth.

The University of Texas has issued a special bulletin on the newly discovered oil fields of that state. The author, William Battle Phillips, Director of the Survey, Austin, Tex., gives numerous analyses with the history and geology of the Texas fields. There are sketch maps and a number of illustrations.

The Department of Colonization and Mines of Quebec has published an instructive report on the mica mines of the province, by J. Obalski, engineer of mines. It contains 63 pages, in French, and gives a list of mica "prospects" as well as the developed mines.

C. H. Rust, city engineer of Toronto, has prepared a very exhaustive report on the disposal of sewage of Toronto, in which he gives much information on the various sewage disposal works he examined on his recent trip to England. Mr. Rust refers to the Exeter and other experiments recently described in detail in Mr. Lea's article, printed in The Canadian Engineer. There are numerous folding maps and several illustrations. Mr. Rust presents four separate schemes for consideration: 1st. An intercepting sewer to discharge the whole of the city sewage into Lake Ontario, 9 miles east of the waterworks intake pipe. 2nd. Septic tanks at Ashbridge's Bay, and filter beds near the Woodbine. 3rd. Septic tanks and bacteria beds. 4th. Septic tanks and single bacteria beds, one series at the outlet of Garrison creek sewer for the west end, and the other at Eastern avenue in the east end.

The Engineering News Publishing Co., 220 Broadway, New York, have published what should prove to be a very useful 40-page handbook of "Mill Building Construction," showing the elements that enter into the construction of mills of different kinds. Notes on materials of all kinds are given with estimates of cost, etc. Various styles of roofing and ventilators are treated of, with diagrams. The author is H. G. Tyrrell, well known to many of our readers, and the price is $1. The same publishers have issued Part III. of Fowler's Engineering studies, dealing with "English stone arches," 16 pages, 25 cents.

The calendar of McGill College and University, Montreal, for 1901-2, makes a book of 384 pages with numerous full page illustrations showing the marked development of Canada's greatest institution of technical training. The information on each department of engineering and applied science is very exhaustive.

The Brown & Sharpe Mnfg. Co., of Providence, R.I., have issued a useful hand-book for apprenticed machinists. This was issued primarily for the use of the apprentices in their own shop, but as there appeared to be a call for a book of this character, they decided to place an edition on the market. The present work does not go into mathematical details but merely gives the necessary information that a young man, who is serving his time at the machinist trade, should know. It will serve a very good purpose. Price, 50c.

Alabaster, Gatehouse & Co., 4 Ludgate Hill, London, Eng., are preparing a new edition of their universal Electrical Directory, which is the oldest electrical directory in the world. The publishers will be glad to have the names of electrical works and electrical manufacturing firms not already reported.

Edward P. Cheyney, professor of European history in the University of Pennsylvania, has made an important contribution to industrial literature in an "Industrial and Social History of England," a volume of 317 pages, just published by the Macmillan Co., 5th avenue, New York. The author describes the manorial system, the guilds, the crafts and the market and trading systems of early Britain, and traces the development of industrial life from the domestic crafts to the factory system of the 19th century, with observations on modern trade unionism, trusts and combinations, profit-sharing and co-operative industry. The origin of profit sharing in England is attributed to Henry Briggs, Son & Co. who adopted it at their collieries in 1865, and found in it a solution of a long standing labor dispute with their miners. In the extending sphere of Government control and the spread of voluntary combinations restricting personal liberty for the benefit of the mass, the author sees a continued reaction from the tendency of the early part of last century—which was towards unrestricted personal liberty in social matters and in labor. The work has a number of factory scenes of the past century.

"The Canadian Contingents and Canadian Imperialism, is a volume of 352 pages by W. Sanford Evans, late of Toronto, now of Winnipeg, recently issued by the Publishers' Syndicate, Toronto. Mr. Evans gives us not merely a connected history of the military operations of the three Canadian regiments we despatched to the South African war, but he gives a study of the Imperial questions that have been quickened into life by the part taken in the Boer war by the British colonies. We realize by this study that Imperial federation is now "within the sphere of practical politics," and we are not surprised to learn that the work has had a warm reception among readers in Great Britain.

Report for 1900 (the 45th annual), on the water and sewerage departments of St. John, N.B., 110 pages with two maps. Wm. Murdoch, C.E., engineer of works.

Miscellaneous Notes.

The war ship Indefatigable was badly damaged by getting aground near Quebec. She has had temporary repairs made at the Levis drydock.

The Montreal Harbor Commission will build workshops at a cost of $12,000 on the guard pier. The present plant will be almost sufficient to equip the shops.

John W. Gerrell, for many years head draughtsman with the Bertram Engine Works Co., Toronto, has received an appointment from a large firm in Sweden.

H. G. Tyrrell, C.E., of Boston, has been employed by the Clergue Syndicate as a specialist to design and superintend the construction of the new steel head gates for the large power canal at Sault Ste. Marie.

Messrs. Rhodes, Curry & Co., have secured the contract for the construction of 100 cars for the Canso and Louisburg railway. The order is a rush one direct from Dr. Seward Webb, president of the company.

Edward Holth has been appointed chief engineer of the Dominion Iron and Steel Co. He acted in a similar capacity in connection with the Pennsylvania Steel Co. He replaces Mr. Waterman, resigned.

The Pittsburg Meter Co., East Pittsburg, Pa., are large manufacturers of water meters, gas meters and gas pressure regulators. Corporations intending to instal meters will do well to study the claims of these meters.

A. C. Douglas has been awarded the contract for the tunnel and portal of the Canadian Niagara Power Co. The amount is over half a million dollars, and the work is to be completed by January 1, 1903. The tunnel is to be 2,200 feet long and 19 by 21 feet in diameter.

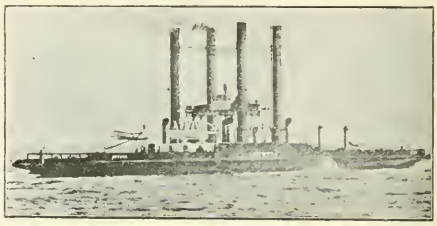
The Montreal Street Railway Co. is making large alterations to its power house in William street. Two engines of 1,200-h.p. each, direct connected to two 850-k.w. 500-volt generators are being installed. One of these is from the Laurie Engine Co., Montreal, and the other from the Pennsylvania Iron Works Co., of Philadelphia.

The Penberthy Injector Company, of Detroit, Mich., report an unusually heavy season's business. They are putting in considerable additional machinery, and are at present arranging to put in ten new lathes to meet the increasing demand for their goods. They now have on the market in addition to their well known and popular injectors a complete line of oil and grease cups, water gauges, etc., and are just entering upon the manufacture of a low water alarm and a force feed lubricator.

Valuable discoveries have recently been made on a large deposit of iron ore 24 miles north of Sault Ste. Marie. The mine was discovered nineteen years ago, but was never developed, on account of distance from railway communication. Now, however, it is reached by the Algoma Central railway, and work is being pushed by the Beitung Iron Co. A vein of specular iron ore, 300 feet wide and 60 per cent pure on the surface, has been found, while the whole deposit is in the nature of a mountain, suggesting comparisons with the Helen mine at Michipicoten. A complete plant of mining machinery is on the way to the mine.

THE NEW I. C. R. FERRY STEAMER.

The Transport, London, Eng., gives the following description of the new ferry boat for the I.C.R. at Port Mulgrave. This is the boat which almost became derilect through running short of coal and provisions on her voyage out. She was picked up by the Anchor liner Furnessia, 300 miles off Newfoundland, and towed to St. John's: A vessel of a very interesting character and bearing the appropriate name of the Scotia, has just been built at the shipyard of Sir W. G. Armstrong, Whitworth & Co., to the order of the Minister of Railways and Canals, Canada, for the carriage of railway trains across the Straits of Canso to and from Port Mulgrave in Nova Scotia. Three sets of rails are laid along her decks, and she is capable of taking over a load of nine Pullman cars, 84 ft 6 in. long each, or a correspondingly large number of box goods cars. She is also specially strengthened to take over an express locomotive and tender weighing not less than 118



tons. The Scotia, whose length is 282 feet, has at the same time been constructed as an icebreaker, since during a considerable portion of the winter months the Straits become congested with large masses of ice that drift in with the tides and winds. On August 24th, the vessel was tried on the measured mile at Whitley with equivalent weights to her working load on board, when she proved herself able to carry out her contract speed, and developed the power necessary for icebreaking. The vessel is built with two sets of triple expansion engines of 1,200-h.p. each, with four large cylindrical boilers, all working at a pressure of 160 lbs., and the shafting is continuous from end to end of the vessel. There is an ice-breaking propeller at each end of the vessel, and she has also rudders at each end, which admit of her being handled in either direction at will.

ENGINEERS' CLUB OF TORONTO.

The Engineers' Club of Toronto held its first meeting of the season on Sept. 3rd. The topic for discussion was "Parks, Squares and Drives for the City of Toronto," led by C. B. Smith, but as he was absent it was not taken up. Meetings will be held on the 1st and 17th of October, and a luncheon on the 31st.

THE WHITE STAR LINER CELTIC.

The Celtic, the new ship of the White Star Line, is now the largest vessel afloat. Her dimensions are: Length, 700 feet over all; beam, 75 feet; depth, 49 feet; gross tonnage, 20,904. She is 9 feet longer than the Great Eastern, 1 foot deeper, and has 10,700 tons more displacement. She is 5 feet shorter than her immediate predecessor, the Oceanic, but of greater capacity, built for accommodation rather than speed, but will steam from 15 to 17 knots with great economy of fuel. The Oceanic, to secure her additional speed of four knots, burns double the amount of coal, and requires 115 more men in her crew. Hitherto the transatlantic merchant steamships have been divided into two classes—one intended primarily for the carriage of passengers and mails, the other for freight only. The demand for passenger accommodation that should be cheaper and less luxurious than that of the highest class has led to a new type of vessel, of which the Celtic is a good representative. They are primarily freight carriers, but have good passenger accommodation. The Celtic can carry 2,850 passengers—347 first class, 160 second-class and 2,352 third class. The Oceanic carries 1,575. The

engines of the Celtic are of the Harland & Wolff quadruple expansion balanced type, the cylinders being 33, 47½, 68½ and 98 inches in diameter, with a common stroke of 5 ft. 3 in. Steam is supplied by 8 boilers, 15 feet 9 inches by 19 feet 6 inches.

ACCIDENT PREVENTION APPLIANCES.

Under the direction of Louis Guyon, chief inspector of industrial establishments for the province of Quebec, a most interesting exhibit of appliances for the prevention of accidents opened at Montreal on the 23rd of September. The exhibit came from Paris, where it was purchased by M. Guyon, who attended the congress on accidents as a delegate. The appliances included fire escapes, saw guards, shaper guards, belt shifters, emery wheel guards, appliances for handling acids, respirators, goggles, chisel guards, planer guards, shuttle guards for weavers' looms, platforms for window cleaning, etc. Mr. Guyon stated that by the use of such appliances the 800 estimated accidents which occur in the province annually could be reduced to probably 300, which would mean the saving of many fingers, toes, arms, legs and eyes, besides many lives. The collection was purchased by subscription among a number of leading manufacturing firms, and was most interesting.

DOMINION IRON AND STEEL CO.

The declaring of its first dividend, 3½ per cent. on its preferred stock, for the past six months, by the Dominion Iron and Steel Co., has awakened fresh interest in the operations of this gigantic industry. A dividend was scarcely expected, as the works at Sydney are still far from completion, and expenditure, rather than income, is characteristic of the company's operations as yet. However a considerable amount of output has been placed on the market, and its pig iron has already gained a reputation, while the price at which it can be furnished must command a sale.

The company has now five blast furnaces in full operation, with a capacity of about 300 tons each per day. By the 1st of November it expects to commence the manufacture of open hearth steel, in 10 furnaces, with a capacity of 50 tons each. It has 400 coke ovens of the most approved pattern, with provision for utilizing the by-products—sulphate of ammonia used for fertilizing, coal tar for commercial purposes, and coal gas, which will be used for fuel in the steel works. While it costs 40 cents to produce a ton of coke, the by-products, which at most works are allowed to go to waste, are worth 70 cents. Everything about the works is first-class and up to date, so that the company should be able to compete successfully with other iron masters in the markets of the world. A steel rail mill will probably be in operation next year, and the manufacture of ship plates will also probably be entered upon.

The future of this industry, which has already shown such wonderful development, will continue to be watched with increasing interest.

NEW CATALOGUES.

[Note—Copies of these catalogues will be sent to readers interested, on mentioning The Canadian Engineer.]

The Joseph Dixon Crucible Co., Jersey City, N.J., monthly calendar blotters.

National Pipe Bending Co., booklet of National feed water heater made by the company.

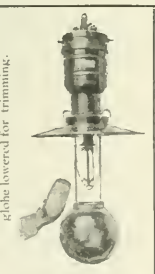
Standard Tool Co., Cleveland, Ohio, booklet in Spanish, describing twist drills (the same in English).

J. H. Williams & Co., Richards St., Brooklyn, catalogue of iron, steel, copper, bronze and aluminum drop-forgings.

General Incandescent Arc Light Co., 572 First avenue, New York, bulletins of electric lamps, supplies and machinery.

Smooth-On Mnfg. Co., Jersey City, N.J., catalogue describing the different metal cements made by the company.

Canadian General Electric Co., 16 King street east, Toronto, bulletin of fusible cut-outs for transformers, lines and switchboards.


Shown with metal reflector raised and globe lowered for trimming.

STYLED FOR OUTSIDE WORK.

"SOLAR"

ALTERNATING CURRENT MULTIPLE ARC LAMPS

ARE GOOD LAMPS

Bulletin sent free showing all kinds—both for inside and outside work.

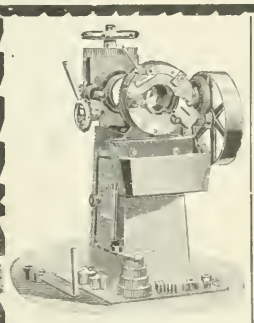
MUNDERLOH & COMPANY, - - MONTREAL.

Everything Electrical ! ! !

SEND ORDER—STATING VOLTAGE AND FREQUENCY.

Shown with clear outer globe and opalescent inner chamber.

STYLED FOR OUTSIDE WORK.


No. 2 Hand and Power Pipe Threading and Cutting Machine.

Machine Tools

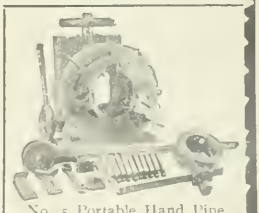
We have a department devoted entirely to

Machine Tools of all kinds

Hand and Power Pipe Cutting and Threading Machines. Lathes, Grinders and other Machine Tools. Send for Catalogue and Prices.

THE FAIRBANKS COMPANY

749 CRAIG STREET, MONTREAL, QUE.


No. 5 Portable Hand Pipe Threading and Cutting Machine

Jeffrey Mnfg. Co., Columbus, Ohio, catalogue of electric locomotives for coal and other mines, steel works and smelters; also electric coal cutters and drills.

The B. F. Sturtevant Co., Boston, Mass., catalogue No. 118, describing steam hot blast apparatus with interesting tables and general information on hot blast appliances.

Buffalo Forge Co., Buffalo, N.Y., catalogue of steel pressure blowers, with tables of dimensions, speeds and capacities; also catalogue of disc fans, and folder describing shavings and dust separator.

Waterous Engine Works Co., Brantford, Ont., catalogue describing various types of the McEwen high-speed engine, including engines direct connected to dynamos, with tables of horse powers, etc.

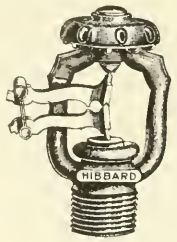
The E. M. Dart Mnfg. Co., Providence, R.I., booklet describing the Dart lubricating stop and waste cock, the Dart union, flange unions, elbows, gas stove cocks, glue heaters, blow-off valves, and other specialties.

M. Beatty & Sons, Welland, Ont., 84 page catalogue of contractors' plant, including dredges, derricks, drilling boats, hoisting engines, ballast unloaders, cable-ways, dumps, dredging and sand pumps, portable boilers, etc.

The Crane Co., valve manufacturers, Chicago, new edition of circular giving lists, dimensions, etc., of flanged fittings and gate valves for steam pressure up to 125 lbs. As measurements have been changed in some cases those interested should have the new circular in making plans for piping.

The Jenckes Machine Co., Sherbrooke, Que., makers of power plant and mining machinery, catalogue of horizontal tubular boilers for brick setting, with numerous tables and diagrams. One section describes the company's power pumps, boiler feed pumps, feed water heaters, and mechanical draft apparatus.

Robb Engineering Co., manufacturers of engines and boilers, Amherst, N.S., catalogue setting forth the principles of steam generation, and a description of the construction and working of the Mumford boilers, with tables and dimensions. From the same firm a description of the Robb hot water heater for house or factory heating by hard or soft coal or by wood.



CLOSED

Automatic Sprinkler Equipments For Protection Against Fire

THE "HIBBARD" SPRINKLER HEAD
THE "NIAGARA" DRY VALVE
WET SYSTEMS. DRY SYSTEMS
FIRE PUMPS, HYDRANTS, &c.

The above appliances are accepted and approved by Canadian and American Insurance Companies, and where installed lowest rates are secured.
The great saving in insurance makes the equipment a paying investment.

WRITE OR PHONE US FOR INFORMATION OR ESTIMATES

The General Fire Equipment Company
Limited.
JOSEPH WRIGHT, President. | WILSON PHILLIPS, Manager.
72 Queen Street East, - - Toronto. Telephone Main 3820.

SUNRISE PACKING

MAKES STEAM AND HOT WATER JOINTS INSTANTLY

Sheet Packing of all kinds
Spiral Piston Packing

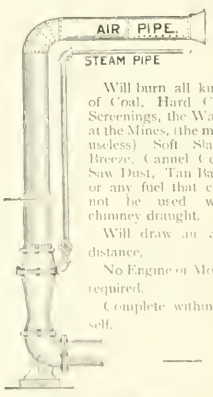
Guaranteed to remain soft and will not blow out under highest pressure.

THE DURHAM RUBBER COMPANY, Limited, BOWMANVILLE, Ontario.

—A dispatch from Copenhagen, Denmark, says that Dr. Sophus Bang, manager of Prof. Finsen's laboratory, inventor of the light cure for lupus, has constructed a special electric lamp, giving a feeble light, but which is extremely rich in chemical rays. The dispatch adds that Dr. Bang used metal instead of carbon "points." The bacteria-killing power of this lamp is 10 times as great as that of an ordinary arc lamp, and a lupus patient requiring 75 minutes' treatment with the arc lamp will require only from three to five minutes' treatment with the new one.

Ex-Governor Ogilvie of the Yukon tells Canadian manufacturers that the freight rates in that territory are against Canadian goods. As an example he cited an experience of his own. He had to construct a steel bridge, and the material, manufactured in Montreal, was laid down in Vancouver at a cost of $6,000. The freight from Vancouver to Dawson was $12,000. He bought 45 barrels of cement in Vancouver, costing $192 and the freight on them to Dawson was $798. On account of the rates, machinery, especially mining machinery, was brought to chiefly from the United States. This of course can be remedied by direct railway communication with the rest of Canada.

Type C.—Improved, Upright Machine.



Will burn all kinds of Coal, Hard Coal Screenings, the Waste at the Mines, (the most useless) Soft Slack, Breeze, Cannel Coal, Saw Dust, Tan Bark, or any fuel that cannot be used with chimney draught.
Will draw air any distance.
No Engine or Motor required.
Complete within itself.

The Highest Medal and Diploma Awarded at the World's Fair, Chicago, 1893.

THE NEW CENTURY BLOWER & EXHAUSTER

It's Right Up-to-Date.

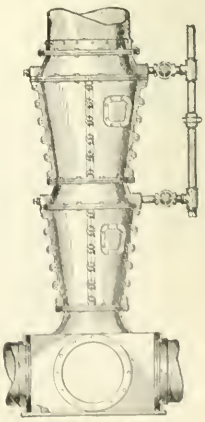
For Pressure Blowing, Ventilating, Exhausting, &c., &c., it has no equal. Uses Steam or Compressed Air.

Made in all size for any duty.

Send for Catalogue.

S. R. EARLE
TORONTO, Ontario.

Earle's Compound Air Inspirator.



Patented in Canada, June 4th, 1901

The Canadian Engineer

VOL. VIII.—No. 19. TORONTO AND MONTREAL, NOVEMBER, 1901. PRICE 10 CENTS $1.00 PER YEAR

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

Toronto Telephone, Main 1392. Montreal Telephone, Main 2589.

BIGGAR, SAMUEL & CO., Publishers,

E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month, or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

	PAGE		PAGE
American Society of Municipal Improvements	440	Miscellaneous Notes	455
Canadian Municipal Convention	436	Metal Trade of Great Britain with Canada	459
Canadian Association of Stationary Engineers	445	New Catalogues	459
Chemical and Bacterial Treatment of Sewage	436	Personal	454
Electric Flashes	450	Railway Matters	453
Electric Illuminations for the Royal Visit	441	Royal Train	443
Facsimile Certificate	456	Royal Trolley Car, First	445
Fires	xvii.	Sanitary Drainage of Houses and Towns	457
German High Speed Electric Ry	446	Souvenir Time Tables	440
Industrial Notes	447	Standardization of Extra Heavy Flanges	440
Marine News	451	Telephone Problem in Canada	438
Mining Matters	452	Water Power Development at Chaudiere Falls	435

Advertisers will please note that this paper will hereafter be published on the 1st instead of the 10th of each month. Changes of copy should be in our hands correspondingly early.

WATER-POWER DEVELOPMENT AT CHAUDIERE FALLS, QUE.

(Concluded from last issue.)

EARTHEN ENBANKMENT.

The earthen enbankment, forming the connection between the bulkhead and the west side of the river, runs from the end of the bulkhead, a distance of about 300 feet, almost parallel to the fore-bay, and then turns at right angles and runs into the west bank of the river, to high ground, making a total length of 600 feet. It is built of well compacted loam (no stone over 3-in. in diameter being allowed in the bank), with slopes of 2½ to 1 on the side towards the water, and 2 to 1 on the opposite side. It has a concrete core wall carried down to an impermeable foundation, which, with the exception of a short section near the corner of the embankment, consists of solid rock. The core wall is in general 2 ft. 6 in. wide, on the bottom, and 18 in. wide on the top. It is built of 1-2-4 concrete without any large stone. This core connects with the bulkhead, and at the angle of the embankment it is carried out so as to form an angle pier supporting one end of the timber glance crib. Where it is carried out to form an angle pier, it is 4 ft. wide on top, with plumb face and a batter of 1½ to a foot on the back. A clay puddle facing three feet thick is laid up along the side of the core wall next the water. A French drain 2 ft. by 2 ft., built of round boulders, is carried along the downstream toe of the bank to carry away any seepage that might come through the bank. So far no leaks have become apparent. The slope of the embankment on the water side is faced with hand-laid rip-rap paving and the opposite slope is sown with grass.

GLANCE CRIB.

This device for diverting ice, etc., is peculiar to Eastern Canada, having first been used on a water-power development at Montmorency Falls, below Quebec. It consists, in the present case, of a heavily framed timber crib 20 ft. wide and 20 ft. high, supported on eight concrete piers 4 ft. wide by 34 ft. long and 8 ft. high, set on line with the flow of the water.

The foundation of this crib is levelled up with concrete to the same elevation as the bottom of fore-bay to protect the bottom from scour from running water. The piers are built of 1-2-5 concrete, laid up in permanent caissons, built of 2-in. by 4-in. spruce laid on the flat, securely spiked and tied across with pieces of the same material. They form nine openings, 8 ft. high by 10 ft. wide, which can be closed in case of necessity by stop logs sliding in grooves placed for that purpose at the upstream end of the piers.

The glance crib rests on stringers set on top of these piers to which they are secured by 1½-in. anchor bolts. It is built of 12-in. by 12-in. face timbers, laid 2-in. apart vertically with 12-in. by 12-in. cross ties at 10 ft. centres in each course, staggered in alternate courses. In the centre of the crib are three rows of 12-in. by 12-in. longitudinal timbers. The intersections of cross ties and longitudinal timbers are notched and securely spiked with ⅞-in. round bolts driven into ¾-in. holes. This size of spike was used throughout. The upstream face of crib is sheathed with two layers of 3-in. plank and thoroughly spiked. The interior is filled with hand-laid stone.

PENSTOCKS.

One penstock only has been placed in position at present, although all the excavation for three large penstocks and one small penstock intended to be installed, has been completed. The penstock now in position is 8 ft. 3 in. in diameter inside the smallest course, and is about 410 ft. long. It runs with a slight fall to the crest of the hill, a distance of 160 ft., and then drops over the hill with an easy curve, and down about 130 ft. and meets a second similar curve from which it runs direct to the power-house, entering by means of a Y shaped connection leading to two separate turbine units. This penstock is laid in a straight line horizontally, and has only two bends, and those of a large radius, vertically. The courses of which the penstock is made are in sections 5 ft. wide, two plates being used in the circumference of the penstock.

From the bulkhead to the first bend the plates are 5/16 in. thick, lapped 3½ in. at joints, double riveted

with 5/8-in. rivets, spaced 3 in. on centres, and 1 1/2 in. between rows of rivets. From the first bend to the lower end of the penstock, the plates are 3/8-in. thick, lapped 4 in. and double-riveted with 3/4-in. rivets spaced 3 1/2 in. on centres and 1 3/4 in. between rows.

The penstock was shipped to the site riveted up in 15 ft. lengths.

The saddles on which the penstock is supported are of structural steel, spaced 15 ft. apart in the horizontal projection. These saddles are built of 6-in. by 4-in. angles, and 5-in. channels with diagonal bracing, the 6-in. by 4-in. angle being bent to fit the circumference and grade of the penstock. They rest on concrete piers into which they are securely anchored by bolts and plates, and they are set with the centre line vertical in every case, regardless of the grade of the penstock.

The penstock is further anchored by 2-in. anchor tie rods. Two angles riveted to the penstock and provided with a pin between them form fastening at the penstock end of these rods, the other end being secured to heavy 3-in. fox bolts running 7 ft. into the rock and grouted around with cement. Turn-buckles are placed on each anchor and are tightened after the fox bolts are set so as to take the load. The anchors are sufficiently long to make the pull as near as possible almost parallel to the centre line of the penstock. At the lower end the penstock is supported by suitable concrete piers, and is also anchored by three tie rods with fastments into rock, as described above; one located directly below the centre line of pipe and the centre line of the other two, making an angle of 45 deg. with a vertical through the centre of the pipe. No expansion joint was placed on this penstock, as expansion and contraction will be taken up in the bends. The penstock was painted with one coat of graphite paint in the shop and two coats of asphaltum paint inside and outside after erection.

Some provision against water hammer is afforded by two Lombard relief valves, set at the lower extremity of the penstock.

POWER HOUSE FOUNDATIONS, ETC.

The power-house measures 52 ft. by 82 ft. outside. The foundations are built of heavy rubble masonry laid in cement mortar up to the springing line of arches, and above this the arches are built of 1-2-5 concrete. The rock bottom, which is of a very shaley nature, is protected by 3-in. plank laid on 12-in. by 12-in. timbers at 3-ft. centres, the space between and under these timbers being filled with concrete.

Tile pipes in the floor run from the generator pits to the switchboard tunnel to carry the leads.

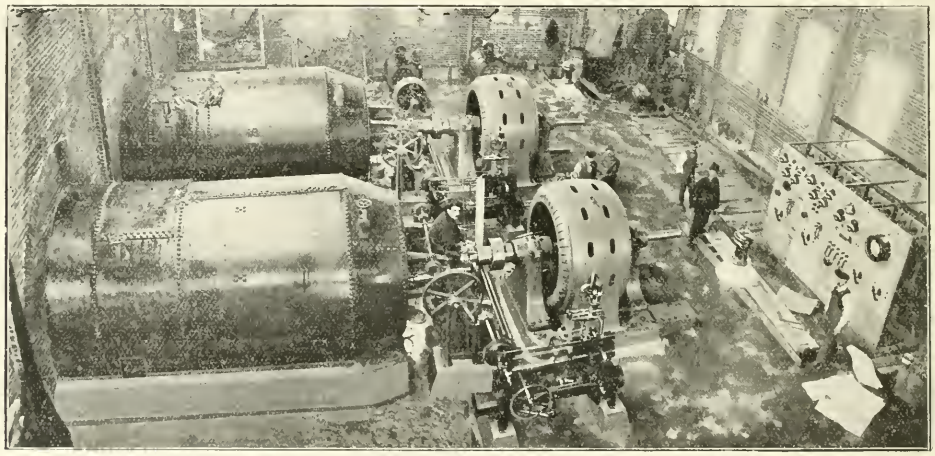
The floor is laid and drains arranged so as to carry away any leakage from the wheel cases and from the vicinity of the generators.

The building is a steel frame structure with lattice columns which carry crane girders and rails for a 15-ton hand-power traveling crane and also the Fink roof trusses. The walls are of brick with stone sills and dwarf mullions at windows.

TAIL-RACE.

The tail-race is excavated through red shaley rock to the end of the rapids below the falls. It is 50 ft. wide and 550 ft. long. Material excavated was used to form an embankment to protect the tail-race and prevent high water in the rapids from flowing into it and backing up on the turbines and thus reducing the head.

A measuring weir, which is to be used in testing the efficiency of the turbines in operation, is placed in the tail-race near the power-house.



Turbines Connected to Generators.

TURBINES AND GENERATORS.

The main turbines run in steel plate wheel cases connected directly on to the ends of quarter turns from the penstocks; the two units now installed being supplied from the first penstock.

The turbine units each consist of a pair of 33-in. cylinder gate, right and left hand, McCormick turbines, on a horizontal shaft, and wheels discharge inwards and downwards into a common central draft tube 5-ft. 6-in. in diameter at the top, and 6-ft. 6-in. in diameter at the bottom.

These units run at 400 revolutions per minute, and are guaranteed to develop 1,400 h.p. each under a minimum head of 110 feet.

The arrangement for operating the gates is designed so as to dispense entirely with any gearing in the wheel cases.

Each unit is governed by a Lombard governor,

which is connected up, through gears, to the shaft operating the cylinder gates on the turbines, by horizontal rods passing through stuffing boxes on the ends of the wheel cases. Two Lombard relief valves, set on the end of the penstock, as mentioned before, are of assistance in controlling the pressure of the water in the pipe. These valves are so arranged that they open and vent the water into the tail-race, under the slightest variation in pressure due to water-hammer or surging in the penstock caused by opening or closing the turbine gates.

GENERATORS.

The generators are 750 K.W. three-phase direct connected machines of the revolving field type, running 400 revolutions per minute with the periodicity 66.6, and delivering current at a normal potential of 10,500 volts, and are capable of a 25 per cent. overload on non-inductive load for three hours without injury, at the same voltage.

EXCITER UNITS.

The exciter units are supplied through a 30-inch steel plate feeder, tapped off the main penstock, provision being made for connecting this pipe with the regular exciter penstock, when this is carried down the hill.

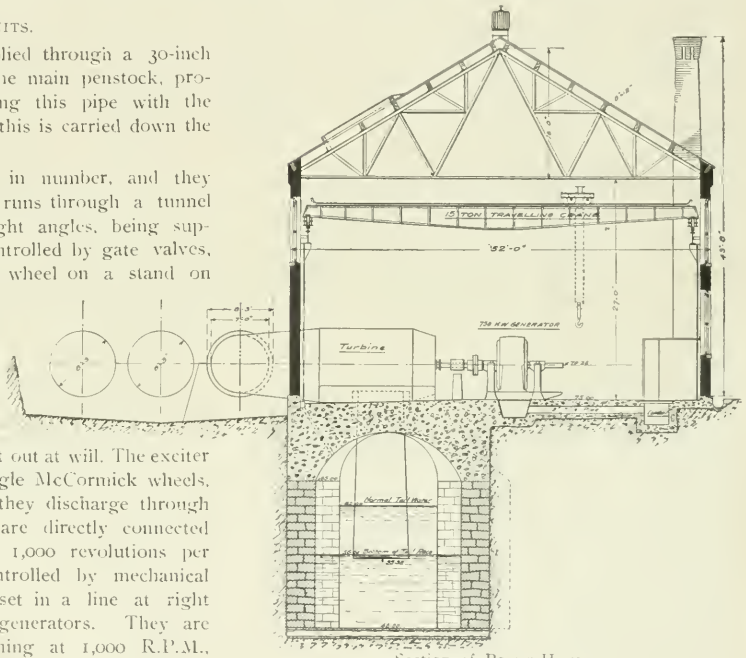
The exciter units are two in number, and they straddle the feeder pipe, which runs through a tunnel below power-house floor at right angles, being supplied through 18-inch risers controlled by gate valves, which are operated by a hand wheel on a stand on floor, and allowing each to be cut out at will. The exciter turbines are special 12-inch single McCormick wheels, set on a horizontal shaft, and they discharge through a quarter turn draft tube, and are directly connected to the exciters. They run at 1,000 revolutions per minute, and the speed is controlled by mechanical governors. The exciters are set in a line at right angles to the line of the main generators. They are 30 K.W., 4-pole machines, running at 1,000 R.P.M., with a potential of 125 volts. Tile pipes also connect the exciters with the main units and the switch-board, behind the latter there is a roomy tunnel for all the wires.

SWITCH-BOARD.

The switch-board is located along one side of the power-house, near the centre of same, facing the generators. The board is of blue Vermont marble, and consists at present of two generator panels, one exciter panel, and one feeder panel. It is equipped with the necessary ammeters, volt meters, with step down transformers, from 10,000 to 100 volts, as well as rheostat for generator's fields, on large machine panel, also the usual current and potential meters for the direct current and rheostat for exciter fields on exciter panel, as well as a three-phase electro-static ground detector on the line panel. The high potential circuits are opened and closed by oil switches and spring expulsion type fuses are used on the line and generator circuits. A set of Wirt lightning arresters are placed on the brick wall inside the building and connected to the line, which leaves the power-house through tile pipe goose necks built into the brickwork.

TRANSMISSION LINE.

The transmission line is about nine miles long, to the city of Levis. The line runs from the down-stream end of power-house, and crosses the river below the Falls, with a span of about 450 feet, being supported on either side by wooden trestles; the wires used are of No. 1 cold-drawn copper, and are placed in the form of an equilateral triangle with 3 feet between each, at this location. The poles are cedar, about 40 feet long, with 7-inch tops, and are arranged to carry eventually three circuits of three wires each. The poles are spaced about 80 feet apart, and the circuits, except at the long span referred to, are of No. 4 medium drawn copper wire.



Section of Power-House.

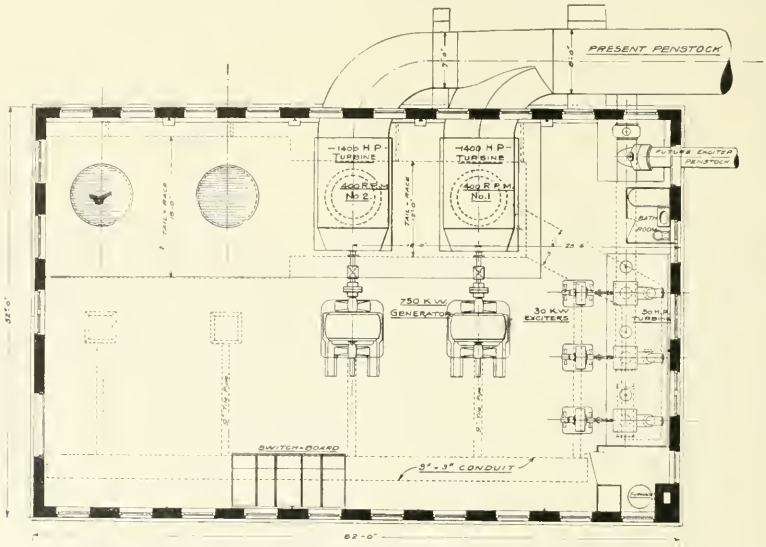
Two substations—one at Etchemin and one at Levis—are used to distribute the current to consumers. The Levis substation is provided with two three-phase to two-phase 150 K.W., oil cooled, Westinghouse transformers, which reduce the potential from 10,000 volts to 2,080 volts. A two-panel distributing switch-board with necessary instruments is also installed here. The other substation has somewhat similar apparatus, but of one-half the capacity.

The main contract involved 30,000 cubic yards of rock excavation, 15,000 cubic yards of earth excavation, 10,000 cubic yards of concrete, 1,800 cubic yards rubble masonry, 300,000 feet B.M. of timber built into cribs, etc., and 8,500 cubic yards of earth embankment.

The market for power and light to be supplied from this development is quite extensive.

The town of Levis, directly opposite Quebec, and

distant nine miles from the development, has a population of 8,000. Between this town and Chaudiere are several thriving villages on the shore of the St. Lawrence, which bring the population up to about 15,000. The company has also the right to enter the city of Quebec, and intends doing so in the near future. The Quebec bridge, across the St. Lawrence near the mouth of the Chaudiere, now in course of construction, will afford means of crossing the river with the transmission line.



Plan of Power-House, Showing Dynamos and Turbines.

The vicinity of the Falls has several advantages for industries using electric power. Three railways, namely, Intercolonial, Grand Trunk and Quebec Central converge within half a mile of the Falls, and it would be an easy matter to run sidings from any of these over to the tracts of level land owned by the company.

Levis, with good facilities for ocean shipping, is within easy reach, and the completion of the Quebec bridge will give direct access to the Canadian Pacific, Great Northern, Quebec and Lake St. John and other railways operating on the north side of the St. Lawrence river. The development is owned by the Canadian Electric Light Company, whose head office is located in the city of Quebec.

The contractors on this development were as follows: Excavation, timber and concrete work on dam, bulkhead, power-house, etc., Engineering Contract Company, New York. Bulkhead steel framing, and penstocks, Carrier, Laine & Co., Levis, P.Q. Power-house, steel framing, and traveling crane, Dominion Bridge Co., Lachine, P.Q. Connection from penstock to wheel cases, J. McDougall, Montreal, P.Q. Turbines and wheel cases, S. Morgan Smith Co., York, Penn. Governors and relief valves, Lombard Water Wheel Governor Co., Boston. Generators and electric equipment, Canadian General Electric Company, Peterborough, Ont.

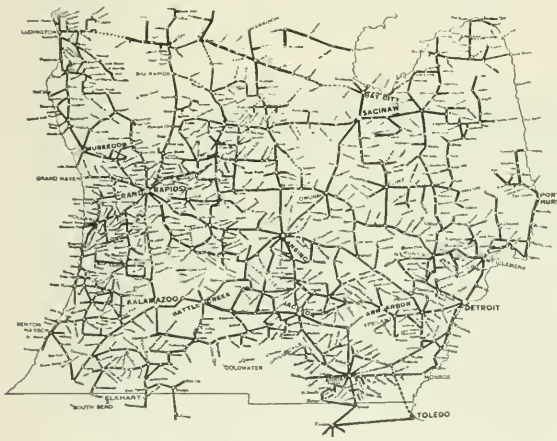
The work was carried out under the direction and supervision of Messrs. T. Pringle & Son, Engineers, Montreal, in accordance with the plans and specifications prepared by them for this entire development.

THE TELEPHONE PROBLEM IN CANADA.

The manoeuvres of the Bell Telephone Company of Canada, during the last five years, culminating in the attempt to get an enormous increase of capital sanctioned by the Dominion Parliament at the last session, should put telephone users and the public generally upon their guard. If the public is not yet fully convinced of the advantage of having the telephone system controlled and owned by the Government, it should at least be made aware that there is another avenue of escape from a dangerous monopoly, and that there is no reason for remaining helpless in the grip of the Hello Giant. In the spasmodic attempts heretofore made in Canada to establish rival telephone companies, promoters have found a certain lack of moral courage on the part of users, who have lived in fear of the great corporation, and to whom the appeal to public spirit and patriotism has seemed vain. These promoters and the telephone public have not seen far enough ahead; they should learn something of what the independent telephone companies of the Western States have accomplished in the past five or six years.

Starting about 1895, in a small way, but with a clear-cut policy, a number of public-spirited men, like J. B. Ware, of Detroit, and E. B. Fisher, of Grand Rapids, have by patience and business foresight got the independent telephone systems of Michigan, New York, Ohio, Pennsylvania and Maryland into a position where the most desperate efforts of the Bell Company of the United States have not been able to shake them; and the "independents" are extending their operations into other States. To give the reader an idea of how firmly rooted these independent systems have become, we present a map showing a sample district served by them, in the State of Michigan, taking Detroit and Grand Rapids as two radiating centres. The fraudulent sale of the Detroit independent company's stock to the Bell interest did not cripple the independent movement in that State, for the number of towns having the Independent is constantly increasing.

and there are now over 24,000 absolutely independent telephones in this State, and in almost every place where they exist, the Independents have not only a larger number of subscribers, but a better service than the Bell. In Ohio the Independents have 71,000 phones against the Bell's 59,000, while in Indiana, the Independent have now 52,000, and the Bell only 24,000. In Ohio, Indiana, Illinois, and Iowa, the Independents have in all 200,000 phones in operation. And this progress has been made in spite of the fact that the Bell Company has cut the rates in every town where opposition starts, and even in some cases given a free service. As an example, we cite the case of Grand Rapids. Here the Bell had 1,471 phones when the Independent was organized in 1895. When the new company got ready to operate in 1896, the Bell, whose rate was $50 for business phones and $40 for residential phones, immediately cut the rate to $24 and $18, respectively, and finally put phones in residences free. Now, in spite of the fact that the Independent Company started with a rate of $36 for business places, and $24 for residences, it steadily increased its business without



Map of Part of Michigan, Showing "Independent" Telephone Connections.

employing canvassers (as the Bell did), till it now has 2,150 business phones against the Bell's 980, and pays dividends at the rate of 8 per cent. a year. At Alpena, the Bell rates are $20 and $3, against $20 and $12 charged by the Independent, and yet the Independent has a larger list. Though the Bell has invariably dropped from its former high figures to rates away below the Independent, the latter have increased their field of operations until they now have within a radius of 50 miles of Grand Rapids, 251 towns, villages and rural toll points in connection, against only 97 operated by the Bell in the same field. These are simply samples of what has been accomplished by the independent telephone companies of other States, which now have an association of their own, at whose meetings the general interests of the movement are discussed, as in any other convention.

On first thought the people of Michigan and other States might be credited with more than the Canadian average of public spirit and moral courage, but the results achieved there are simply the outcome of careful business plans combined with a more thorough study of the telephone problem than appears to have been given to it in Canada. Into the details of these methods we hope to enter in another article, but at this point it will be sufficient to explain that one of the keys of the success of the Independents is their willingness to have telephone rates fixed or regulated for the greatest length of time. In Michigan we do not know of an independent company that has not been willing to be bound by the rates it first announces, even to the extreme limit allowed to a State charter, which is 30 years. It is at this point that the Bell balks, and this peculiarity of Bell policy will explain why the Canadian Bell Company so suddenly withdrew its bill for increased capital, when the question of regulating rates was discussed in Parliament. Though before an Independent starts in a Michigan town, the Bell rates are always higher, and though after the Independent gets into operation, the Bell always cuts the price to unprofitable figures, yet it will not agree to have its rates regulated for a period of years. The reason becomes obvious to the patrons of the Independent, and they stand by their local institution, especially when it is proved that at the Independent Company's rates there is a fair profit in which any citizen may share, if he wishes to take stock. Moreover, the Bell's cutting of rates in many places enables the telephoning public to get the use of the two systems for the former price of the Bell alone. Almost invariably the Independent lines give a better service, for the reason that the Bell Company, apparently secure in its monopoly, has been content to stand still, comparatively speaking, in the matter of improving its instruments, while the several makers of independent instruments have striven hard and very successfully to give the best possible instrument as their only hope of success. The result is that to-day the Independent lines are equipped with instruments that far outclass the Bell, and are at the same time supplied at a much lower price.

With regard to the dependence of the telephoning public upon the Bell for long distance transmission, the Independent patrons first feared they would be badly handicapped, but experience has proved the contrary, while a centre like, say, Toronto or Montreal, can gather around itself a net-work of town and village connections, to a distance of about 50 miles, which supplies their long-distance needs for ordinary trade. We shall show in another article how this works out, and prove that there is at once a good field for the investment of local capital, as well as a relief from the present monopoly, in the organization of such independent companies in Canada, if started with a right understanding of the work in hand.

A new apartment building, to be erected in Toronto by the Union Trust Co., will contain 48 apartments and cost over $150,000.

The Ontario Government is being asked for assistance for two important drains in Lambton county, one of which would benefit 40 farms, the other 200. Mr. Pettypiece, M.P.P., is interesting himself in the matter.

Jenkins Bros., of New York, have received the following awards at the Pan-American Exposition at Buffalo for their goods: Gold medal for Jenkins Bros. valves, gold medal for Jenkins' '96 packing, two silver medals for rubber specialties.

STANDARDIZATION OF EXTRA HEAVY FLANGES.

Steam pressures varying from 100 to 250 pounds pressure entered into engineering practice about the year 1889. For pressures less than 100 pounds there had long existed confusion regarding standards for flanges of pipe, fittings and valves. A schedule of standard flanges was adopted, July 18, 1894, by a committee of the Master Steam and Hot Water Fitters' Association, a committee of the American Society of Mechanical Engineers, and the representatives of the leading valve and fitting manufacturers of the United States. As the use of high steam pressures became more general there came into existence so many different diameters, thicknesses, drilling circles and number of bolts for flanges on fittings, valves and pipe for extra heavy pressures that manufacturers could not safely keep stocks of goods, and mill architects and engineers were greatly delayed at times in making up specifications for contemplated work on account of time taken to find out what the different manufacturers could or would furnish.

Recognizing the need of a standard for extra heavy, J. C. Meloon, mechanical superintendent of the General Fire Extinguisher Co., Providence, R.I., issued an invitation to the leading valve and fittings concerns of the country to meet and consider this subject. In response to this invitation several of the largest concerns sent representatives to a meeting at New York, April 24, 1901. At that meeting a committee was chosen to formulate a standard. This committee consisted of, J. C. Meloon, Mech. Supt., General Fire Extinguisher Co., Providence, R.I.; J. F. O'Brien, secretary, the Pratt & Cady Co., Hartford, Conn.; L. R. Greene, engineer, Walworth Mnfg. Co., Boston, Mass.; H. D. Gordon, M.E., Jenkins Bros., New York, N.Y.; F. A. Strong, Supt. Eaton, Cole & Burnham Co., Bridgeport, Conn., and F. A. Connet, engineer, Builders' Iron Foundry, Providence, R.I. Mr. Meloon was made chairman, Mr. O'Brien, secretary. The committee had various sessions and submitted to the manufacturers interested the following recommendations and schedule for standard at a meeting held in New York, June 28, 1901:

No. 1—Multiples of four for drilling.

No. 2—Drilling should straddle vertical axis.

No. 3—Bolt centres not to exceed 3⅝-in. except 2½-in. size. Committee at first proposed 8⅝-in. bolts, but sample elbows and flanges were drilled and bolted together, and it was found that 8⅝-in. bolts interfered with inserting bolts.

No. 4—Distance from centre of bolt to edge of the flange should always equal or exceed the diameter of bolt plus ⅛-in. for 9-in. valves and under, and diameter of bolt plus not less than ¼-in. for sizes larger.

No. 5—

Size of Pipe. Inches	Dia. of flange. Inches.	Thickness flange. Inches.	Dia. of bolt circle. Inches.	No. of bolts. Inches.	Size of bolts. Inches.
2	6½	1	5	4	⅝
2½	7½	1	5⅞	4	¾
3	8½	1⅛	6⅞	8	⅝
3½	9	1 3/16	7¼	8	⅝
4	10	1¼	7⅞	8	¾
4½	10½	1 5/16	8½	8	¾
5	11	1⅜	9¼	8	¾
6	12½	1 7/16	10⅝	12	¾
7	14	1½	11⅞	12	⅞
8	15	1⅝	13	12	⅞
9	16	1¾	14	12	1
10	17½	1⅞	15¼	16	⅞
12	20	2	17¾	16	1
14	22½	2⅛	20	20	1⅛
15	23½	2 3/16	21	20	1
16	25	2¼	22½	20	1
18	27	2⅜	24½	21	1
20	29½	2½	26¾	24	1⅛
22	31½	2⅝	28¾	28	1⅛
24	34	2¾	31¼	28	1¼

No. 6—The bolt circle diameters as above stated will allow the use of calking recess on pipe flanges provided such device is specified. The schedule presented was unanimously adopted by the manufacturers present and Jan. 1st, 1902, was the date set for adoption of same. A large number of the leading manufacturers of the United States have agreed to adopt the standard and put it into effect January 1, 1902; while others agree to furnish the standard when desired by their customers. A limited number of the schedules will be printed by the committee, and copies can be obtained of the secretary, J. F. O'Brien, P.O. Drawer No. 66, Station A., Hartford, Conn.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS

The eighth convention of the American Society of Municipal Improvements was held at Niagara Falls on Oct. 1—4. The attendance was small, but the papers and discussions were of great interest. The attendance was no doubt affected by the fact that several other societies devoted to municipal interests exist. The president in his address expressed the opinion that the massing of people in very large cities will not continue as in the past, owing to the tendency of manufacturing plants to scatter, and the improved transit facilities. Small cities are better adapted than large ones to the life of the people. He thought the influence of cities on the life of the country would soon be controlling, therefore, the cities should have the best, and the function of the society was to give them this.

A number of committees gave in reports, to which further reference will be made on a future occasion.

Among the papers read were, The Local Park System of Wilmington; Asphalt: Its Compounds and Nature; Possibilities of Coal Tar in Bituminous Pavements; Pavement Guarantees; Portland and Natural Cements for Concrete Pavement Foundations, (by C. H. Rust, of Toronto); Experience with Wooden Pavements; Wooden Pavements at Home and Abroad.

Mr. Rust, Toronto city engineer, expressed the opinion that the day is not far distant when Portland cement will be entirely used for concrete pavement foundations. He also spoke well of wooden pavements, and saw in them a means of holding the asphalt companies in check. He found, however, the Australian hard woods losing favor in London.

A number of important papers on sanitary engineering subjects were presented.

SOUVENIR TIME TABLES.

The railways over which the Royal party passed on their recent visit issued special time tables for the use of the party.

The Grand Trunk prepared an annotated time table for the sections of their road over which the party passed. It is entitled: Through the Provinces of Ontario and Quebec, Canada, and as a specimen of typographical skill is really beautiful. It is on heavy paper, profusely illustrated, and contains descriptions of the places passed.

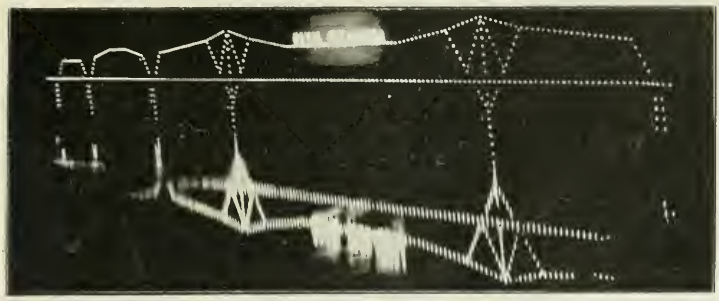
The C.P.R. had a special issue of their cross-continent annotated time table, entitled: Across Canada. They also prepared a little book under the title of The Royal Visit to Canada, in which the Royal train and the various points visited are described and illustrated.

Specially bound copies of these hand-books were presented to each member of the party, who will doubtless preserve them as pleasant souvenirs of the trip.

—Edwin O. Sachs, chairman of the British Fire Prevention Committee, London, Eng., has just been advised that a large silver medal, accorded by the German Empress, in connection with the Fire Congress of June last, has been presented to the executive of the committee, as a mark of appreciation for the services rendered by that body in the demonstration of scientific and economic aspects of fire protection. It may be remembered that a deputation of the committee, comprising Edwin O. Sachs, Ellis Marsland, F. R. Farrow, and C. E. Goad, accompanied by the secretary and engineer, visited Berlin in the summer, and that an important exhibit of technical models and photographs was loaned to the German authorities for the exhibition held in connection with the congress. This is the first medal of the kind presented to an English scientific body.

ELECTRIC ILLUMINATIONS FOR THE ROYAL VISIT.

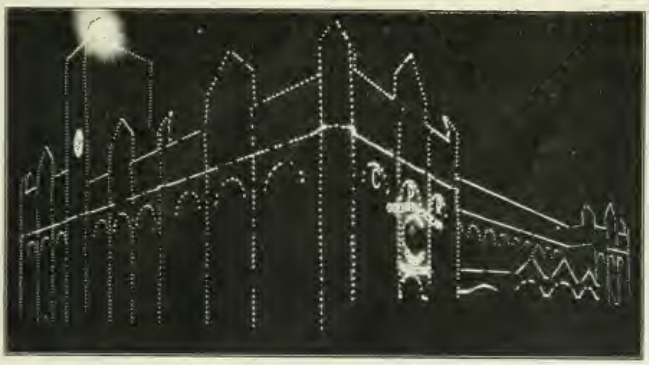
We give herewith a few samples of electrical illuminations which turned night into day during the visit of the Duke and Duchess of Cornwall to the chief cities of Canada. When King Edward VII. visited Canada as the Prince of Wales 40 years ago, gas jets were just coming into use for night celebrations, but the old pine-knot and turpentine



Interprovincial Bridge, Across Ottawa River.

torches, with tallow candles for interior lighting, were still the chief reliance in Canada for street festivities. Now, to celebrate the visit of his son to Canada, miles of incandescent electric lights shed their steady glow over our streets, while

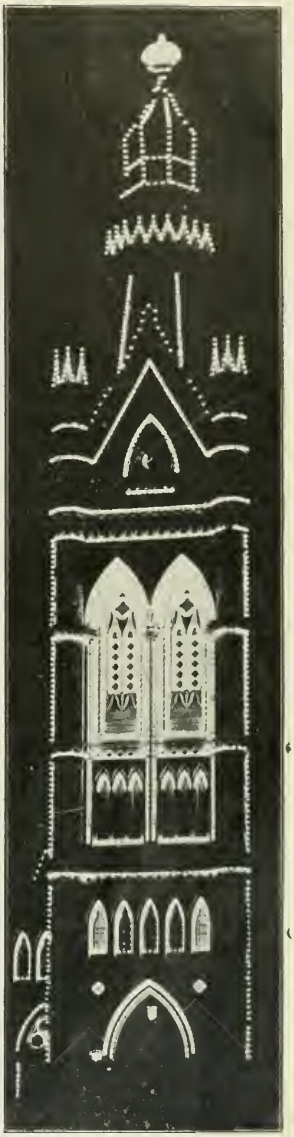
The above engraving and that of the Parliament Buildings and tower are from photos made by the Jarvis Studio, Ottawa.



Windsor Station, Canadian Pacific Railway, Montreal.

electric search-lights pierce the clouds or sweep the horizon half a hundred miles away.

To give an idea of the development of electricity as a means of illumination we may say that in the three cities of



Tower of Parliament Buildings.

Parliament Buildings, Ottawa

Montreal, Toronto and Ottawa, about 135,000 incandescent lights were used during the Duke's visit, over and above the regular service. In Montreal the Royal Electric Co. supplied about 26,000 lights, the Lachine Rapids Co., 16,000; the Standard Light and Power Co., 3,000; the Imperial Electric Co., 6,000; the Grand Trunk railway and Canadian Pacific railway about 10,000 together, and other plants say 4,000 or 5,000, or say 60,000 for Montreal. The total in Toronto was about 50,000 lights, the current for which was supplied chiefly by the Toronto Electric Light Co., while Ottawa showed 20,000. Ottawa's illumination, as far as the public buildings were concerned, was carried out under the supervision of Ahearn & Soper, the capital city's pioneer electrical firm, and as the sample illustrations here presented will show, the designs were most effective and pleasing. Special attention was given to the interior of the Senate chamber of the Parliament Buildings, and taken altogether the illumination of the Parliament Buildings, inside and out, was said to equal in taste that of the Pan-American Exposition. One of the Ottawa papers described the Senate chamber lighting as follows: All the gasoliers and electroliers had been permanently removed from the chamber, and the old heavy panelled ceiling replaced by one composed entirely of luxfer prisms through which the soft rays of 1,000 incandescent lights, placed above and out of sight, penetrated. Just inside the chamber stood two flower stands between which the guests passed on their way to the throne. Midst the growing flowers in the stands were hundreds of Duchess of York roses made of Bohemian glass. Inside the roses and concealed by their petals were tiny incandescent lamps which lighted up the rooms with a mellow glow. Two similar flower stands stood to the right and left front of the throne. The beautiful gothic arches of marble in the chamber were outlined in hundreds of incandescents of the size of marbles.

Provincial Parliament Buildings, Toronto. Photo by Galbraith Photo Co.

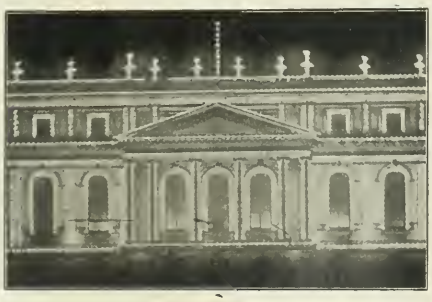
New General Offices of Grand Trunk Railway, Montreal.

Beneath the arches and resting against the panels of the chamber were hung festoons of smilax and electric Duchess of York roses. Each festoon was joined at the junction of the base of the arches with a wreath of smilax and roses through which as in those of the festoons, glowed a soft entrancing light. On each side of the throne stood a column upholstered in red plush and mounted with the new Royal crown having nine pearls on each side. These pearls consisted of miniature incandescent lamps pearl shaped and frosted. The columns were entwined with smilax and miniature lamps. The piece de resistance was the throne itself, upon which stood their Royal Highnesses and their Excellencies Lord and Lady Minto. Ordinarily the drapery of the throne is beaded perpendicularly at intervals of about two inches with gold and crimson cord. Last night the beads were composed of miniature lamps. Above the throne and

Bank of Montreal, Place d'Armes Square, Montreal.

facing a canopy of diamonds over the Royal party were thousands of miniature lamps radiating from a central point and drooping in graceful curves to the columns on either side to which they were attached. A greater artistic triumph it would be difficult to attempt.

The Parliament Buildings and Osgoode Hall in Toronto were fine samples of artistic illumination, and in Montreal the two chief railway offices, and the Bank of Montreal were considered among the most effective of the commercial capital.



Amateur Photo by R. A. Walker

Portion of Osgoode Hall, Toronto.

The remarkable thing about these wonderful electrical displays, involving an expenditure of over $125,000, and the use of thousands of horse-power for current, in the three cities named, is that notwithstanding the haste with which they were carried out not a single accident occurred, nor did any of the illuminations fail. Of course many other Canadian cities did equally well according to their opportunities, but these engravings are shown merely as samples, and do not include dozens of buildings equally worthy of reproduction

The American Cereal Company has been reorganized as the Quaker Oats Co., with a capital of over $3,000,000. It is building a large mill at Peterboro, Ont., and will acquire the Peterboro Hydraulic Co.

THE ROYAL TRAIN.

As so large a part of the tour of the Duke and Duchess of York through Canada would be over the Canadian Pacific railway it was arranged that the special train for their Royal Highnesses should be furnished by that company. It was made up into two sections, the second of which was devoted to the royal party, and consisted of day and night coaches, dining car and cars for the employees and baggage—eight or nine cars in all, vestibuled throughout. Views of the day coach named the Cornwall, and the night coach, called the York, are here shown.

A Corner in the Boudoir.

The Cornwall is 78 feet 6½ inches long. It contains reception room, boudoir, dining room and kitchen. The reception room is paneled in Circassian walnut. The ceilings are finished in dead gold, and the moldings and ornaments are just touched with gold and blue, the decorations being of the Louis XV. style. The hangings are of dark blue velvet, while

A Panel in the Boudoir.

the floor is carpeted with a heavy Wilton of gray-green. The sofa, arm chairs and other furniture are upholstered in blue velvet. The piano is of Canadian manufacture. The car is lighted by eight large plate glass windows on the side, and by the glass panels of the door and rear wall. The Duchess

boudoir is between the reception and dining rooms. Its prevailing shade is a pearl gray. The panels are painted a la Watteau. The lattice work of the ceiling, by which ventilation is secured, as well as the ornaments of the panels are touched with gold. The draperies are of light blue moire silk, and divans, chairs and table are gilt to match the panels. The dining-room is finished in Airican Coromandel, ornamental cartouches in bas relief displaying at one end the armorial bearings of the King, and at the other the blended coats of arms of the Duke and Duchess, while the arms of the Dominion, and the family badge of the Duke embellish the remaining walls. The draperies are of green velvet, and the decorations of the panels are in shades of gold and green to match. The upholstering is of a warm, brown tone. The dining table accommodates eight persons.

Reception Room in Day Coach.

The night coach York is 78 feet 2 inches long, and a corridor extends through its length. The central portion is occupied by two bedrooms with servants' sleeping rooms adjacent. These bedrooms are finished in pearl gray enamel; being paneled in silk to match the draperies. Each contains its own wardrobe, dressing table and large mirror, with brass bedsteads. In addition to the ceiling lights, each room has a special fixture for the dressing table. The draperies of the Duke's room are of crimson silk armure, and those of the Duchess of pale blue moire. The furniture is of satinwood.

Bathroom and Lavatory.

Each of the Royal bedrooms has its own bathroom attached. These are draped in a soft, tasseled waterproof cloth of a pearl gray hue. The baths are full sized upholstered round the borders with this same waterproof cloth, and have heavy curtains of a similar material. The remainder of the car is devoted to two state rooms finished in mahogany; the one for the lady in waiting, the other for the gentleman in waiting, together with a general toilet, and a baggage room.

The train was fitted out with electric lights and telephones. The electric lighting equipments were furnished by the Gould Coupler Co., of New York, and consist of an axle driven dynamo for charging the storage battery, and a battery for lighting the car. There is one of these complete equipments of double the necessary capacity under each car, the total number of 8-C.P. lamps on the train is 435, the

Room in Compartment Car Showing Telephone.

coaches averaging 60 each, and the two baggage cars 10 each. In addition there is an engine and dynamo equipment in the baggage car taking steam from the locomotive, as a stand-by should anything go wrong with the axle equipments. This auxiliary equipment is hardly necessary, as the train is so interconnected that any car can light any other from its batteries or charge the batteries of the disabled car from its dynamo.

The capacity of the batteries under each car is 600 ampere hours with a discharge rate of 100 amperes, and the voltage

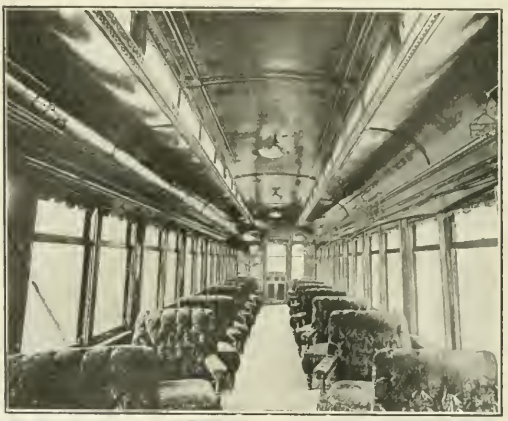
Bedroom in Night Coach.

used is 25, so as to cut down the number of cells required, and also to admit of the use of 2.5 watt lamps which are possible on this low voltage. The operation of the equipment is as follows: When the train attains a speed of say 20 miles a flyball governor switches the dynamo, which has acquired the proper voltage, on to the one section of the battery which it

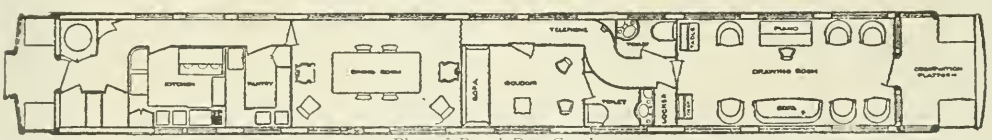
charges, while the other equal section of battery lights the car. As the speed of the train increases the dynamo voltage would also rise were it not that the machine is hung in such a way that the increased current sent to the battery requires more horse-power than the belt will stand without slipping, which it proceeds to do, thus keeping the dynamo speed and consequently the voltage within the limits allowed for battery charging. This dependence upon a slipping belt for voltage regulation might seem the height of foolishness, but the results of the operation of this system on a number of other cars of the company have been very satisfactory. The lamps for train lighting are frosted or iced glass of candle pattern or the usual pear-shape, mounted in candelabra and other artistic fittings on the walls and in movable stands, on tables where required. There is also a complete telephone system with an exchange, with instruments in each car for general use, and private instruments in the Royal apartments. To obviate the difficulties of the jarring the transmitter and receiver are mounted on the same handle at the proper relative distance from ear and mouth. Considerable ingenuity had to be displayed in making the connections from car to car to provide for uninterrupted service, and the results have justified the care taken, as communication was had at all times from any point on the train to any other. This was installed by the Bell Telephone Co. The electrical equipment was installed under the supervision of Robt. A. Ross, consulting electrical engineer to the C.P.R.

Three types of engine were employed for hauling the train. (1) Ten wheeled passenger engine on ordinary sections of the road; weight of engine and tender when loaded, 130½ tons; diameter of driving wheels, 5 ft. 9 in.; cylinders, 20 by 24 inches; steam pressure, 200 lbs.; length of engine and tender over all 61 ft 1½ in. (2) Consolidated engine used in the mountain districts; weight of engine and tender when loaded, 132 tons; diameter of driving wheels, 4 ft. 9 in.; high pressure cylinder, 22 inches diameter; low pressure, 35 inches diameter; stroke, 26 in.; steam pressure, 200 lbs.; length of engine and tender over all, 61 ft. 5⅛ in. (3) Prairie flyer, used in the prairie country traversed by the C.P.R.

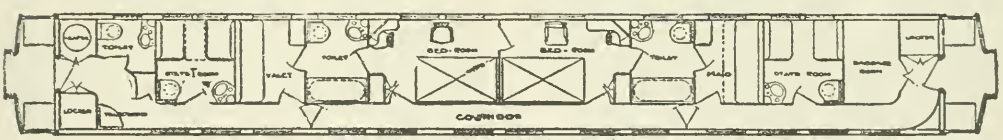
each end. The interior is finished in polished oak and bird's eye maple, and there are two plate mirrors at each end. There are fourteen large easy chairs upholstered in olive green plush, and the floor is carpeted with blue velvet. The trimmings, such as hat racks, etc., are bronze. The trucks are double and of swing motion pattern. The electric equipment consists of four 50 h.p. Westinghouse motors with Westinghouse air brakes, and is capable of a speed of 50 miles per hour. The car is lighted by five clusters of electric lamps.



Royal Electric Car.



Plan of Royal Day Coach.



Plan of Royal Night Coach.

—The annual convention of the agents in the employ of the Union Steam Pump Co., of Battle Creek, Mich., of which Darling Bros., of Montreal, are the Canadian representatives, was held during the last week of September. The idea of holding such a convention is good, as it brings the agents together, gives them the opportunity to see the works where the pumps are made, the process of manufacture, compare methods of work, and gain general information as to how best to further the interests of their employers and themselves. A number of papers were read and discussed. The social feature was of course not lost sight of

THE FIRST ROYAL TROLLEY CAR.

What is said to be the first electric car built specially for royalty was recently turned out of the shops of the Ottawa Car Co. for the Ottawa Railway Co. to be used by the Duke and Duchess of York. The car, the interior of which is here shown, is 50 ft. long with straight sides and vestibuled at

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

There was a large attendance at the regular meeting of the Hamilton branch of the Canadian Association of Stationary Engineers on the 10th ult., and the series of open meetings for the season was thus very successfully started. President F. J. Sculthorp occupied the chair. The feature of the programme was a paper on the Metric System of Weights and Measures, read by James Gill, B.A., of the Collegiate Institute staff. Mr. Gill had a chart tacked to a blackboard and worked out many problems. So thoroughly did he explain the system that when he got through almost every person in the audience was impressed with the fact that it was the only proper system and many purchased copies of the chart issued recently by the Canadian Engineer, from the secretary. Mr Gill's paper was supplemented by remarks from Principal John Ireland, of the School of Art and Technology. By blackboard illustration, it was shown with what simplicity and saving of time problems of measurement could be worked out by the metric system, as compared to the laborious process entailed by our system. In concluding Mr Gill mentioned the advantage to exporters of machinery etc., to Europe of using the metric system of measurements in specifications and correspondence. On motion of Ald. R. C. Pottinger, a vote of thanks was passed to Mr Gill. After the paper, Wm. Morris gave an interesting talk on the machinery he saw at the Pan-American Exhibition and a number of questions were answered from the question drawer.

Toronto No. 1 branch of the Canadian Association of Stationary Engineers held its first open meeting in Engineers' Hall, 61 Victoria street, on October 18th, president, W. J. Webb, in the chair. William Bourne, superintendent of the Toronto Electric Co., gave a very interesting talk on dynamos, motors, and their troubles. Bro. Bourne explained fully the causes of common troubles, and showed how to detect them and how to bridge over some of them temporarily. With the aid of the blackboard he explained the way to connect up different kinds of motors, which was very much appreciated by the members. These open meetings will be held the third Wednesday of each month at 8 o'clock in the above hall, during the winter months; all are welcome. The subject for the next meeting will be "The Necessity of a License Law." This branch will hold its annual dinner at the Walker House on Thanksgiving eve., Nov. 27th. Tickets may be obtained from W. J. Webb, Lawlor Building, or other members of the committee.

GERMAN HIGH-SPEED ELECTRIC RAILWAY.

By O. Lasche, Chief Engineer Allgemeine Elektricitats Gesellschaft.

(Continued from last issue.)

COLLECTOR BOWS.

The current is led to the three vertically superposed wires, from which it is taken into the car through bow-shaped collectors. By this system of taking off the current, any deflections of the working wire between the connecting points do not affect the bow, a jumping of the latter being less likely than if it has contact from below. Notwithstanding this fact, the question of the collectors had to be very carefully studied, and although the requirements of the work to be effected at a speed of 50-60 meters (165 to 196 ft.) per second could only be very incompletely complied with, an experimental arrangement was nevertheless made. At both ends of the car the three arms are arranged on the roof for the three different phases. The distance between the arms is determined by the space required by the bows to turn round their vertical axes. These distances are, however, kept as small as possible, and the arms are located close to the pivots of the bogies with a view to avoiding in the curves any material change in the distance up to the overhead wires. Two systems of bows were considered necessary, so that in the event of one failing to act, no sparking is produced, but the current is taken from the other bow. This endeavor to increase the number of contact surfaces was carried still further with a view to reducing to a minimum the weight of the parts which slide along the wires. A number of aluminum bows were connected by plate springs of different length to the arm itself. This elastic arrangement was to ensure a first-rate permanent bearing action, and in the event of one bow getting off, to ensure that the others should be sufficient for collecting the current. For larger deviations of the conducting wire, the main spring arrangement of the whole arm begins to act.

THE BODY OF THE CAR.

The car was built for 50 passengers. In consideration of the lengths required for the apparatus room and driver's cab, the over-all length of the body of the car is 21 metres (68.9 ft.), and the distance between buffer plates is 22.1 metres (72.5 ft.). The full width of the car is 2.6 metres (8.53 ft.). The body of the car remains in all its parts within the standard profile, but the middle part with the wide air-holes comes close up to this limit. The windows of the car are closed, ventilation taking place through the side windows of the very high skylight. On either side, at both ends of the car, are provided doors for the entrance and exit of the passengers. The driver's cab is shut off from the passengers' by a wide partition extending from the bottom to the top of the car, and serving as a back support for the occupant. On the sides thereof are grated doors, which during the stoppages at the station are arranged in such a manner that the driver's cab remains shut off from the passengers, granting them however access to the interior of the car. During the drive these doors are so adjusted that they block the exit and at the same time shut off the passengers, preventing them from disturbing the driver in the execution of his duty. By the apparatus room the car is divided into two compartments. The passengers can, however, freely pass from one compartment to the other, even when on the journey, in which case the apparatus room is protected in a similar manner to the driver's cab. Those parts which are liable to be touched by the passenger either do not carry current, or are suitably insulated. As will be seen in the description of the cable arrangement, the passenger compartments and the driver's place are not under tension. The bows on the roof of the car are fitted with two insulators connected in series, each of which is tested to a potential of 20,000 volts. The high-tension current passes from here to the transformers through high-voltage cables, which although they have been tested for 20,000 volts, are carried on high-tension insulators. Between the apparatus room and the passengers' compartments, and in the same manner between the passengers' compartments and the transformers suspended below the same, there are air shafts which form a double partitioned space.

Fig. 5—One of the Trucks.

The storage batteries provided beside the transformers are likewise separated by double sheet metal walls. The body of the car in its present construction is not of the shape generally expected for a vehicle running at high speed. The car is slightly curved at the ends, and not sloped off like the bow of a ship. The statements concerning the experiments which were made in this respect are contradictory, notwithstanding that they prove that boat-shaped ends are of no advantage. One of the objects of the experiments is to clear up this point and to ascertain the difference in consumption of power at varying speed, also in the event of head and side winds. A suitable screen can be constructed at any time.

THE CAR TRUCKS.

The two trucks, which carry the body of the car, are 13.3 metres (43.6 ft.) apart. The diameter of the wheels was assumed to be 1.25 metres (4.1 ft.), thus enabling the trucks to swivel, sufficiently below the car, while allowing the floor of the car being of the same level throughout its whole length. Each of the trucks has three axles, the two outer ones carrying the motors, and the middle axle had to provide the necessary space for the pivot and the air cylinders of the Westinghouse brake. The distance between the wheels measures 2 (6.56 ft.) by 1.9 metres (6.23 ft.). Fig 5 shows one of the

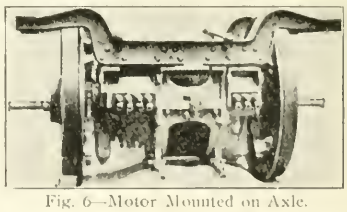


Fig. 6—Motor Mounted on Axle.

trucks and the arrangements of the motor within the same. The load for each axle was less than the maximum allowed and amounted to a little over 14 tons. An arrangement of springs bearing against the body of the car is not provided. The bogies themselves are supported against the axles by two sets of springs. Each axle box carries a strong plate spring, to the heads of which supporting springs are attached, which carry the frame. On these axle boxes, i.e., on the shoe of the axle spring, plate springs are provided for carrying the motor. The connection between this spring and the motor frame is established by a curve block, against which the spring bears, and on which it rolls off. By these shoes the spring action or its degree of elasticity can be varied. The first few millimeters it acts as a weak spring, then it begins to be more rigid, and at a deflection of about a quarter inch it becomes

stiff. In the almost impossible event of these very strong springs breaking the motor is supported by the wheel axle with the interposition of a suitable metal packing close to the side of the wheel hub. The condition for the selection of a material for such packing was that it must be very soft for protecting the axle and hollow shaft, yet of sufficient resistance for bringing the car to a standstill before serious damage can be done. The motors are firmly bolted to a riveted plate frame. The motor is protected against lateral movements by guide blocks, which bear against a corresponding guide on the frame of the truck. The casing of the motor is prevented from turning round by rods which only allow of its vertical movement (Figs. 6 and 7). The transmission of the work from the motor to the wheels is effected by an elastic coupling entirely independent of the bearing construction (Fig. 9).

(Concluded in next issue).

Industrial Notes.

A new steel bridge is being placed in position at Salem, over the Grand River.

On their return from the coast the royal party visited Ogilvie's mill at Winnipeg.

The earnings of the United States Steel Trust for the past six months were nearly $55,000,000.

Tenders are asked for a number of asphalt pavements, concrete sidewalks and sewers, in Winnipeg.

Gordon, Ironsides & Fares announce that they will add a canning plant to their abattoir industry at Winnipeg.

Carleton Place has added a grader and steam road roller to its good roads plant, and is improving its streets.

The Robb Engineering Company has received an order from the Copp-Clark Co., Toronto, for a 40-h.p. engine.

Hespeler has to deal with a claim of the Guelph Pavement Co. for $1,800 extras on a contract of $2,700 for macadam and granolithic sidewalks.

The Imperial Starch Co. will soon commence manufacturing at Prescott. Dr. J. D. Reid, M.P., has been appointed manager.

The Noxon Agricultural Works at Ingersoll have passed into the hands of Riley & Cotter. The Merchants' Bank is also interested in the purchase.

The Windsor Plaster Co., Windsor, N.S., are enlarging their plant, and have ordered a 100-h.p. boiler and engine from the Robb Engineering Co., Amherst, N.S.

E. C. Crowther, now of Milwaukee, Wis., formerly superintendent of the blast furnace of the Steel and Iron Company, Hamilton, has brought suit against the company to recover $500 for wrongful dismissal.

The strike at the Kingston Locomotive Works was settled by the men going back to work, with permission to lay their complaints before the management after they had started, but with the man who was dismissed not reinstated.

The American Bridge Co. has brought an action against John Patterson and the Preston & Berlin Street Railway Co. for the erection of the Freeport bridge, the contract for which was $17,150. The defense is that the bridge is not according to contract.

The Winnipeg city council has let tenders for waterworks supplies as follows: J. H. Ashdown, pig lead, $78 per ton; Canada Foundry Co., cast iron water pipe, $36.07 per ton; Canada Foundry Co., specials $51 per ton; E. H. Bissett, 4-inch valves, $6, and 6-inch valves, $10, on condition that they be found satisfactory as to dimensions and weight.

A by-law to regulate the use of horse shoes on the city pavements in Winnipeg provides that there shall not be allowed upon any such shoes circular corks less than three-quarters of an inch in diameter at the point where the cork rests upon or touches the pavement. The by-law also prohibits square horse shoe corks less than three-eighths of an inch square at said point.

A by-law, authorizing waterworks, has been carried in Southampton.

The Ottawa sawmills have commenced shipping their saw dust to New York, where it is utilized for industrial purposes.

A bridge broke down at Moorfield, over the Conestoga river, recently. Tenders are asked for a new bridge in wood and steel.

The Stratford Water Company has found a leak in its water mains which is responsible, it is said, for the waste of about 500,000 gallons daily.

Four wells were sunk on the waterworks property at London, to an average depth of 129 feet, and at a cost of $800, but without improving the water supply. A test well will be sunk on the East London waterworks property.

J. A. Jamieson, the well known elevator builder of Montreal, is erecting for the Canadian Northern railway, at Port Arthur, an elevator of 1,250,000 bushels capacity. It will be of steel and wood, and will be ready in December.

John Ditrick and Richard Walker, of Perth, were seriously injured by the explosion of an acetylene gas machine, which they were repairing in the storehouse of Shaw & McKerracher. A similar accident occurred to Mr. Shaw a few weeks ago.

R. A. Donald and T. B. Greening, proprietors of Pure Gold Manufacturing Company, Toronto, have secured a permit for a new $20,000 factory. It will be a handsome structure of buff-colored pressed brick, four stories high, with a frontage of 60 feet and a depth of 185 feet.

Blue Lake is likely to be the site of the power-house for the proposed Brantford, Paris, St. George and Galt Electric railway. The electric company will endeavor to arrange with the Ontario Portland Cement Co. to establish a public park on the property of the latter.

The Chaudiere Hotel Co., of Ottawa, is seeking, in addition to maintaining hotels, power to erect an iron bridge for foot passengers over the Rideau canal between Major's Hill Park and Lover's Walk, in the city of Ottawa, and to build a subway from the Central Station, under the Sappers bridge, Rideau street and Mackenzie avenue.

John Darby, of Wrexham, England, general manager of the Brymbo Iron & Steel Co., North Wales, has been on a visit to Sydney, C.B. The Brymbo concern, which he represents, is the first industry in the United Kingdom to use the basic open hearth steel process for treating phosphoric pig iron for the manufacture of steel, a modification of which—the Bertrand-Thiel process, which was first employed in Austria—will be used by the Dominion Iron & Steel Co. Mr. Darby speaks very highly of the quality of the iron made at Sydney.

J. C. Wilson & Co., of Glenora, Ont., inform us they are preparing plans for a flume wheel, which they intend to make in sizes to suit any requirement, and which they expect to get on the market this winter. This style of wheel is in request where it is not desirable to spend so much in preparing wheel pits, etc. The firm, in order to meet the increasing demands for the "Little Giant" turbine, are enlarging their foundry. They are also removing their old cranes and replacing them with cranes of ten tons capacity, so that they will be in a position to accept orders for much heavier work than they have been able to handle in the past.

The Durham Rubber Co., Ltd., Bowmanville, Ont., is steadily working its way to the front. It has been in business only a short time, but already the expansion of its trade has compelled it to add large extensions to its original factory. New additions are now well under way and when completed will more than double its capacity. The new battery of boilers and the machinery now being installed are of the most modern types, and no expense is being spared to bring the plant to a state of highest efficiency. The company reports business far in excess of last year, and is anticipating large trade in the coming season for which it has already closed some large contracts. In belting and packing they claim to be in a position to offer better values than any on the market. In visiting their factory one receives a cordial welcome, and cannot fail to be impressed with the air of a healthy business.

The foundation of the Wallaceburg beet sugar works has been laid.

La Compagnie de Pulpe de Peribonka has increased its capital stock to $100,000.

James & Reid, of Perth, are about to build another addition to their machine shop.

P. Sayers, of Nassagaweya, has purchased 49 acres of pine near Corwhin, on the C.P.R., and will build a mill this winter.

Tenders are asked for blocks for street paving in Johannesburg, South Africa. Preference will be given to Canadian material.

Eight hundred names have been enrolled at the Toronto Technical School for the session, showing the demand for this kind of training.

A recent visit was made to the Trent Valley Peat Fuel Co.'s works by a party from Peterboro and Lindsay. About 60 square miles of swamp is available for peat.

A combination of sulphite manufacturers of the United States and Canada is announced, to be known as the United Box, Board and Paper Company, with a capital of $10,000,000.

It is now stated that the Globe File Works at Port Hope will not be closed, but that the Mechanics Star File Works, of Levis, Quebec, will be merged in them, and the capacity doubled.

Representatives of United States barbed wire factories are in Canada for the purpose of looking up a suitable site for a factory. For the first time in six months they have overtaken their orders.

The C.P.R. is using compressed air for power in its Winnipeg shops. A pressure of 90 lbs. to the square inch is employed. Among other things the outside of box cars are painted with paint blown on by the air.

A wire rope ferry is to be established across the Yukon at Dawson. The rope, which will be 4,000 feet long, probably the longest single span in the world, is made of plow steel wire, and will stand a strain of 175 tons per square inch.

The L. S. Starrett Co., of Athol, Mass., has for the accommodation of its western trade, opened a store at 15 South Canal street, Chicago, where a full stock of Starrett tools will be kept. Capt. A. T. Fletcher is manager.

E. H. Palmer, of Geneva, N.Y., has written to the mayor of Kingston, offering if the city acquires the plant of the K. L. H. & P. R.R. to buy the gas works, and supply gas at not more than $1.25 per 1,000 feet. The citizens are now paying double that price.

The Pittsburg Reduction Company has arranged for the operation of its Canadian plant, situated on the St. Maurice river, about 12 miles from Three Rivers. The plant is said to have cost about $1,000,000, and has a capacity of about 10 tons of aluminum a day. The product is to be exported to Great Britain as well as supply the Canadian market.

There is a prospect of the reconstruction of the bridge across the St. Francis river to connect Richmond and Melbourne. J. W. Harkom, president and manager of the Richmond County Electric Company, has purchased from the St. Francis Bridge Co. the wreck of the five-span iron structure which was carried away by the ice last April, and which now lies in the river, and is arranging to have it raised.

The fact that this has been a busy season among iron manufacturers is attested by the improvements and enlargement of plants in the country. J. C. Wilson & Co., of Glenora, Ont., say that they have found it necessary to increase their foundry facilities, and that for months past they have been compelled to work their staff night and day in order to give their patrons good service.

J. C. Langelier, superintendent of forest rangers, who has just returned from a visit to the Gaspe district, reports the existence of two great water powers on the Magpalon river capable of furnishing 3,500 and 13,500 h.p. respectively, besides an inexhaustible quantity of the finest pulp wood and an abundance of material for making hydraulic cement and paint. On the north shore is another fall on the Manicouagan with a power equal to that at the Shawinegan Falls, and one on the Outarde, besides others of lesser value.

A $3,000 addition is to be built to Fearman's pork packing establishment at Hamilton.

The Laurentide Pulp Co. has made 18 per cent. profit on its capital stock during the past year.

A new bridge is to be built over the Bonnechere river at Eganville. It will probably be of steel on stone piers.

The Dominion Government has built a number of good roads to El Dorado, Hunker, Bonanza and Dominion creeks in the Yukon.

The Spanish River Pulp Co.'s works at Webbwood, now under way, will have a capacity of 100 tons of ground wood pulp per day. The hydraulic works will furnish 10,000-h.p.

The Clergue enterprises at Sault Ste. Marie have given the town a boom. About 1,000 dwelling houses have been built during 1901, and a sewage system is being constructed. Already it has waterworks and electric light. Mr. Clergue is constructing a power canal on the Michigan side of the river.

The contracts for the Lanark county House of Industry have been let, as follows: Mr. Brantford, of Almonte, stonework; Mr. O'Neil, of Almonte, carpenter work; Brown & Reid, of Smith's Falls, heating, plumbing and lighting. The total amount of the contracts is $17,700.

The Minister of Public Works has disapproved of the plans for the new elevator at Montreal, for which the contract was recently awarded to J. A. Jamieson. The grounds of rejection are that the building is deficient in strength from the foundation to the top of the bins, and that the bins are too weak. Much dissatisfaction is expressed over the delay.

A new and interesting industry that will consume scrap tin, battered stove pipes and old tin cans as its raw material is being established in Toronto. The process is at present carried on only in Germany and Belgium, and one large Toronto firm ships its refuse tin there, as it is the only market. The firm name of the new enterprise is the Ontario Chemical Works. Chemicals will be also manufactured, particularly washing soda. The manager is James M. Neil, and Loren R. Vorce is consulting engineer.

The C.P.R. authorities have under consideration an immense scheme of irrigation for the Northwest, by which it is proposed to make a good farming and grazing country out of the millions of acres which now lie dry and arid, between Calgary and Medicine Hat, immediately north of the railway line. James Anderson, the leading irrigation engineer of the world, who has done such gigantic work in California, Egypt and other places, has recently been over this area, and reports that there is nothing to prevent the great work being successfully carried out, and it is understood that as an experiment 300,000 acres of the three million barren acres will be put under irrigation.

R. H. Buchanan & Co., Montreal, manufacturers of pumping machinery, are putting in position for the C.N.R., Quebec, one 12 x 6 x 12 duplex steam pump, and 4,000 feet of pipe for supplying the tanks at Shawinegan Junction. They have just completed three 40,000 gallon tanks, including Blake steam pumps, boilers and one 18 x 10 x 12 Underwriter fire pump for the Bell Telephone Co., Montreal; one for the Nichols Chemical Co., Capelton, Que.; one for the Meaford elevator at Meaford, Ont.; one 60 foot steel tower and 10 foot mill for the Varennes waterworks, and a Blake steam pump for the Montreal Gas Co. They have also completed for the Midland Elevator Co., Midland, Ont., a fire protection plant.

The tunnel now under construction at the Canadian Niagara Power Co.'s works is to form the tail-race of the power plant. It will be about 2,200 feet long, and will empty into the Niagara river below the Horse Shoe Falls, opposite Table Rock house. The inside dimensions of the tunnel are 17 feet in height and 18 ft. 10 in. in width, horse shoe in form with curved invert. It will be through soft clay shale on the top which will require to be timbered, and limestone on the bottom and will be lined with 10 inches of brick throughout except at the portal where the work will be of the best class of limestone and granite masonry work. The contractor for this work is A. C. Douglass who already has the shaft sunken 160 feet at a point about midway between the wheel pit and the portal to the bottom of the tunnel, and has commenced to drive the tunnel. It is expected that this work will take about 18 months to complete.

The peat works at Beaverton are turning out from 8 to 10 tons per day of pressed peat.

The plant for the manufacture of steel shells at the Dominion arsenal has arrived at Quebec.

The Winnipeg city council propose submitting a by-law for the inauguration of a municipal gas plant.

Brauch & Fach have been awarded a contract to erect a new soap factory for Pritchard & Werlich at Preston.

The first horseless carriage has reached Victoria, B.C. It was imported by W. M. L. Trench, of Saanich. It is run by steam.

A by-law to grant a bonus of $20,000 to Thomas Bros., of Norwich, for a woodenware factory carried at St. Thomas by a majority of 28.

The Ontario Government is making an enquiry into the peat industry. W. E. H. Carter, of the Bureau of Mines, is visiting various works to obtain information.

Collingwood is likely to be chosen as the site of a large boiler and engine works by a Toronto firm, which will be associated with the Collingwood Shipbuilding Co.

The hardware business of J. H. Ashdown, Winnipeg, will be incorporated. The applicants are: J. H. Ashdown, A. Buehler, J. A. Lindsay, John Emslie and Isaac Pitblado. Capital, $1,000,000.

A new cement company, with a capital of $300,000, has arranged for a ten-acre site for a factory on Ashbridge's marsh, Toronto. The company expect to turn out 1,000 tons per day. The raw material will come from the township of King.

The regulations governing the granting of licenses to cut timber in the railway belt of British Columbia have been amended, so as to provide that it shall all be manufactured within the Dominion, before being exported.

Charles Dumes and Alexandre Campignon, representing the largest steel manufacturing works in France, are in Canada, looking for a site for a distributing branch of their establishment. They employ 4,000 men the year round.

Two Parisians, who represent a wealthy French syndicate, are in Canada for the purpose of establishing extensive pulp mills on the Saguenay. They have had experience on the Baltic and think they can manage winter navigation on the St. Lawrence.

Work on the proposed binder twine factory at Brandon is to be proceeded with at once. The structure will be of stone and brick, 200 by 45, 15 feet high, with a metallic roof. Adjoining the factory will be a warehouse, 80 by 150, capable of storing 5,000,000 pounds of binder twine.

The Grand Trunk railway proposes to construct a modern grain elevator on Windmill Point, Montreal, as soon as the harbor authorities consent. R. A. Waite, of Buffalo, the architect who planned the G.T.R. general offices, has been commissioned to prepare plans, which will, it is said, be of an entirely new style of grain elevator.

J. C. Wilson & Co., of Glenora, Ont., report the following recent shipments of "Little Giant" turbines: John Frederick, Holloway, Ont., 14-inch vertical; Simeon Howes, London, England, two 6-inch, one 18 inch and one 24-inch deep vertical; Sloan & Brooks, Elora, Ont., one 12-inch deep vertical; T. F. Linott, Sparta, Ont., one 12-inch standard vertical, and the Canada Machinery Agency, Montreal, an 18-inch standard vertical for a customer at Labelle, Que.

Dr. Stansfield, the new professor of Metallurgy at McGill College, Montreal, has entered upon his duties. His work will be carried on in conjunction with that of Dr. Porter, professor of mining. Dr. Stansfield's record is a good one. He is a doctor of science of London University, and an associate of the Royal School of Mines, South Kensington. For the last three years he has been teaching at the Royal School as assistant to Sir William Roberts-Austen, in the metallurgical department. He was engaged in research work for seven years, and has written a couple of papers for the Iron and Steel Institute on metallurgy, and was joint author of another upon alloys for the Physical Congress of Paris, and has conducted extensive researches for the Institution of Mechanical Engineers of England.

The business men on St. Paul street, the principal business thoroughfare of St. Catherines, want an asphalt pavement.

The Nova Scotia Steel and Coal Co. has selected a site for blast furnaces at North Sydney. Graham Fraser will be manager.

Arrangements have been made by the Dominion Government to select their 50,000 acres of coal lands in the Crow's Nest district.

A joint-stock company, with a capital of $40,000, to manufacture furniture, is asking for a bonus of $5,000 from Gaspé.

Stephen Melvin and Omen Schofield, of Horton, Kings county, N.B., carrying on business as the Black River Steam Mill Co., have assigned.

Hugh Burnett, of Peterboro, has been awarded the contract for a dam on the Otonabee river in connection with the Trent Valley canal works.

The British Columbia Marine Railway Company, Vancouver, is going to secure an extensive steel and iron plate working plant in connection with the docks.

The Canada Wood Specialty Co. and N. Janes & Sons' veneer factory at Collingwood have amalgamated under the former name, with Chas. B. Janes as manager.

The American Steam Gauge and Valve Mnfg. Co. has been awarded the gold medal at the Pan-American for gauges, pop valves, indicators and engineering specialties.

Experts figure the cost of the recent great steel strike in the United States to have been to the men about $10,000,000 in wages, and to the companies $15,000,000 in earnings.

An order for twenty more engines has lately been received at the Kingston Locomotive Works. The shops are to be lighted by electricity and the dynamos have been placed in position.

The Canada Foundry Co., of Toronto, is opening a branch at Winnipeg, under the management of C. E. Mackenzie, who has been attending to the business of the Canadian General Electric Co. at Winnipeg for the past three years.

Ross and Howard are erecting a large foundry and machine shop in Vancouver, and will pay special attention to marine construction and repair work. Next spring they will install ship-ways for handling larger vessels.

The Consumers' Gas Co., of Toronto, has awarded to G. A. Bronder, mechanical engineer, of New York, a contract valued at about $100,000 for new equipment of their plant. Mr. Bronder has given the Link-Belt Engineering Company of New York, an order for conveyors which will be over 5,000 feet in length. This order is valued at nearly $30,000. The B. F. Sturtevant Co., of Boston, is to supply the blower equipment. Owing to the duties a large portion of the material will be forwarded from the United States and finished in Canadian factories.

F. H. Clergue has practically decided upon the construction of another water power canal to cost upward of $2,000,000. Associated with him in this enterprise are Widener and Elkins, of Philadelphia, who, it is understood, will furnish half the capital. The new canal is intended to develop about 20,000 h.p. electrically in the rapids of St. Mary's river, opposite the ship canal. The St. Mary's Falls Power Company, organized a short time ago, has made application to the Board of Supervisors, in accordance with the Michigan State statute, requesting permission to divert the waters of the river for the project. The plans contemplate the construction of two parallel dikes, 150 feet west of the line of the International bridge. The dikes will be 3,100 feet long, and the lateral distance between them will be 480 feet. The fall of water will be about eighteen feet. Mr. Clergue says that power can be developed here at a cost much less than at Niagara. The waterpower developments now made and projected at the Canadian Sault will furnish 125,000 h.p. for manufacturing purposes alone. It is proposed to build a railway from the power house on the dike, and it will be connected with the mainland on the American side, above the falls by a bridge.

Electric Flashes.

Telegraph rates to the Yukon have been materially reduced.

The Canadian General Electric Co. is about to open an office in London, Ont.

The Hamilton Street Railway Co. is experimenting with a new and very powerful brake.

An electric light plant has been installed at Strathcona, N.W.T., a suburb of Edmonton.

A by-law to raise $7,000 by debentures for electric lighting and street improvements has been carried in Beeton.

The Canadian Northern railway has placed telegraph operators at every station along its lines for the convenience of grain shippers.

The Duke of Cornwall and York stated that the electric illuminations at Ottawa were the best he had seen in any part of the world. It is said that Toronto excelled Ottawa.

The Brandon Electric Light Co.'s station on the Little Saskatchewan has been tested and found to work satisfactorily. It will be put in operation immediately.

The earnings of the Toronto Railway Co. reached their maximum on the day of the military review, during the Royal visit, when they reached $11,334.

The United States Navy searchlights which were in use on the tower of the Toronto city hall during the Royal visit were distinctly seen at Niagara and other points about 40 miles distant.

The People's Heat and Light Co., Ltd. Halifax, is in financial difficulties. It took over the Halifax Gas Light Co. in 1896. The bondholders have agreed to defer action in the hope it may recover.

W. R. Brock, M.P., president of the Canadian General Electric Co., has been presented with an oil portrait of himself, by his fellow directors. It was painted by E. Wyly Greer, and will be hung in the board room at Toronto.

The day the Royal visitors were in Montreal was the best day the Street Railway Co. ever experienced. Nearly 300,000 passengers were carried, compared with 125,000 or 150,000, which is usually the number on a holiday or fine Sunday. Over 350 cars were in use.

The Winnipeg Street Railway Company and the Ogilvie Milling Company have combined, and will bring their power from a point on the Winnipeg river, 50 miles distant. The plant will cost about $1,000,000, and will probably be used for heating as well as power and light

Marconi has invented a system of wireless telegraphy by which automobiles in motion may communicate with each other for a distance up to 20 miles, which, he says, may be increased. He has also succeeded in telegraphing by his wireless system, 350 miles, which is double the distance hitherto.

The C. Turnbull Knitting Co.'s factory at Galt has been fitted out with electric lights to the number of 300. The work was done by H. Dakin. The distribution is attained by a lately devised means known as the closet system. The closet is of wood, about six feet high, four inches deep and two feet wide. It is fastened to the wall, and as a fire preventative it is lined with asbestos.

Mr. Johnson, a London electrical engineer, has invented a new system of wireless telegraphy, which does away with some of the objections of the Marconi system. High masts are done away with and messages cannot be tapped in transmission. As the patents are not completed little information can be obtained, but the new system is understood to be devised somewhat on the same principle as a stringed musical instrument. The transmitter is fitted with vibrating reeds and the receiver with tuning forks, which are synchronized with the transmitter, so that the waves coming in contact with any other receiver not so synchronized, would have no effect. The apparatus has been tested by the British Admiralty with satisfactory results.

An electric plant is to be installed at the Sun cement works, Owen Sound.

A by-law to borrow $12,000 for an electric light plant has been carried at Iroquois.

The Canada Carriage Co., Brockville, is having its own electric plant put in its factory.

The Bell Telephone Co. has notified the Montreal city council that it will open up a number of streets to lay conduits.

The Almonte town council has purchased Metcalfe Bros. water power for $13,000 to run the municipal electric light plant.

The Royal Military College at Kingston is installing an electric light plant of its own. Queen's University will shortly do the same.

The city council of Winnipeg wish to secure from the Dominion Government a lease of the power at St. Andrews locks on Red river, for electrical purposes.

The Cunard steamships Lucania, Campania and Umbria have been fitted with the Marconi system of wireless telegraphy. The Etruria will also be fitted out.

Brantford is to have a system of radial railways, an agreement having been reached between the Street Railway Co. and the Von Echa Co., by which the latter obtains running powers.

The Winnipeg city council will submit a by-law to the ratepayers at the municipal elections in December to provide for raising money to improve the lighting facilities of the city.

Lincoln county council has given the right of way to the H. B. & G. railway for an extension from Beamsville to St. Catharines. Work on the extension must begin before May 1, 1902, and be completed on Nov. 1, 1903.

The promoters of the Kakabeka Falls power scheme at Port Arthur are endeavoring to arrange for the immediate installation of a plant. Power will be supplied to both Fort William and Port Arthur if the project goes through.

A route is being surveyed for an electric railway from Toronto to Brockville, which it is also proposed to extend to Ottawa and Cornwall. This is a new survey of an old line. The present promoters have not yet secured their charter.

The C.P.R. has had an electric alarm installed at Brock road crossing, near Galt. W. C. McConnell, of the Railroad Supply Co., of Chicago, did the work. It rings automatically when a train is 1,500 feet from the crossing, and can be heard quite a distance.

The Lachine Rapids Co. has been awarded the contract for lighting Westmount at $90 per lamp. The Royal had offered to take the contract at the same rate as in Montreal, but when three days later, the deal was made for $60 a lamp, the Royal withdrew the offer.

The Cornwall Electric Street Railway Co. are installing in the old mill of the Cornwall Milling Co., new dynamos for operating their system. The turbines will be turned by water-power, but the old steam plant will be kept in working order ready for emergencies.

The Toronto Junction council has accepted the offer of the Humber Light and Power Co. to supply 100 arc lights of 2,000-c.p., to be run the same number of hours as the lights in Toronto, and every night, for $60 per light per annum, lamps to be the latest improved standard alternating arc light. The company agrees to purchase the town's plant

The Canadian Mute, discussing the merits of the akoulalion, which it is claimed makes the deaf to hear as no other invention has done, questions its great utility. It says that for the partially deaf it may be of some benefit, but in the great majority of cases it would appear to be of doubtful permanent use. To the totally deaf it is of no practical use. It says the sensation produced by the instrument is felt, not heard.

The Cornwall canal is henceforth to be lighted by electricity. The power house is at Shieck's Island dam, and the power generated will be used for working the lock gates as well. The installation is very complete. M. P. Davis, of Ottawa, had the contract, and C. E. Taylor, C.E., who had charge of construction, will be manager. The lights at the locks and weirs will be kept going all winter. There are 250 lamps in use.

Sarnia Street Railway Co. has adopted the Sleeman fender.

The Bell Telephone Company are putting up a metallic circuit between Renfrew and Pembroke.

The Wire and Cable Co., Ltd., of Montreal, have commenced to erect a large new factory on Lusignan street.

The Toronto Electric Light Co. is about to build a handsome office at 12 Adelaide street east, to cost $30,000.

The St. Louis council has given the Montreal Street Railway Co. the right to extend its lines into their municipality.

The great fire at Sydney, C.B., on Oct. 19th, destroyed the Cape Breton electric light works and the Eastern Telephone Co.'s office.

York township council has replaced the coal oil lamps in Little York with Meriden carbon arc lamps. Two have been also placed at Norway.

Horace Payne is in British Columbia to look into the affairs of the British Columbia Electric Railway Co. operating Vancouver and Victoria.

A Buffalo syndicate is said to have bought the Peterboro electric street railway for $150,000 and will extend it to Lakefield, seven miles. E. M. Block will be manager.

The Canadian General Electric Company has secured offices in the Y.M.C.A. building, Winnipeg, which will be in charge of C. E. Mackenzie, their western representative.

A complete system of telephones is to be installed in the Windsor Hotel, Montreal, one in every room, or about 400 in all. Occupants will be able to talk from their rooms, not only to the office and each other, but over the city and long distance systems.

The Belleville street railway was closed last month pending its sale. The Bank of Montreal had been operating it. The city council has now arranged to purchase it from the bank for $6,700, and to sell it to Mr. Vandyke, of Grimsby, who is to pay for it in instalments and extend it to Trenton by August next.

A system of telegraphy which has been installed between Budapest and Fiume, a distance of 375 miles, by two Hungarian scientists, is said to have a speed of 40,000 words per hour. The system is an ingenious combination of telegraph, telephone and photography, the messages being written on sensitized paper by a ray of light, and then developed and fixed by an automatic process. The message is produced in Roman characters.

Dr. Jennie Gray, of Toronto, is the first lady physician in Canada to use an automobile for professional calls. It is a storage battery vehicle made by the Canadian Motors, Ltd. It has a hood like a doctor's buggy, and has an ingenious device for discovering the numbers of houses in dark streets. This is an electric lamp connected to the battery by a cord several yards long. Alighting before a house the doctor turns the switch on and with lamp in hand makes sure of the number with no loss of time and no disturbance of a household to find out whether it is the right place or not.

Great interest has been awakened in England by experiments with the Armstrong and Orling system of wireless transmission of electrical energy, doing through the ground what Marconi has done through the air. At two points 400 yards apart a spike was driven into the ground with the telephoning instruments attached. Communication was readily established. Mr. Armstrong has a plan for varying the pitch or tone in which the radiations are sent. There are forty thousand tones which pass without nullifying one another. Other experiments gave wireless control to torpedoes from land 500 yards away. A development of this invention might render obsolete the finest fortifications, and the new submarines, needing no crew, would be converted into torpedoes. Mr Armstrong pressed a button, and an unconnected lamp, two miles and a half away, instantly lighted. When he pressed the button again the light was extinguished. Unlike Tesla's experiments, Armstrong's feats are accomplished with very low voltage. The same thing may be done through water.

Henry Hogan, president of the Montreal Bridge Company, has offered to instal a street railway system at Longueuil. A by-law to light its streets by electricity under consideration.

A 300-kilowatt storage battery has been installed in the Engineering Building at McGill College, Montreal, so that the building can be lighted without keeping the steam plant running. It is charged by one of the 50-h.p. steam dynamo units, remodelled for the purpose.

Marine News.

H.M.S. Indefatigable, damaged at Quebec by going ashore, will be repaired at Halifax, at a cost of $200,000.

Swan & Hunter, of Wallsend on Tyne, are said to contemplate the establishment of ship building works in Cape Breton.

A new ferry line is being established in Sydney to give regular service between North Sydney, Point Edward and Westmount.

The Union Steamship Company's new steamer Cassiar has been launched at Vancouver. She has been equipped with Scotch marine boilers.

The three-masted schooner, Charles L. Mitchell, has taken a load of sulphite of ammonia at the Steel Company's pier, Sydney, for South Carolina.

The loss of the British steamer Cobra was due to her having broken her back across two waves, her hull not having been strong enough for her machinery.

The Newfoundland and Boston Steamship Co. has been organized, with a capital of $1,000,000, for the purpose of trading between St. John's, Nfld., Halifax, Boston and the West Indies.

The Victoria Marine Depot has completed a new steamer for the fishery protection service in British Columbia waters. She developed an eight-knot speed on her trial trip. Another is to be built.

Another steamship has been wrecked on the Pacific coast, the Hating, of the C.P.R. line running to Skaguay—which ran on Jervis Island in a fog and foundered. She is valued at $200,000, and has been rescued. The passengers and crew escaped.

The Imperial Government has renewed the ten years' agreement, by which consular mails to the East are carried via Canada, but gives notice that, at the expiration of that time, if faster vessels are not put on, the mails will be sent by the Suez Canal.

Shipbuilding has been brisk in Nova Scotia the past summer. Ten vessels have been launched at Shelburne, and two steamers and three schooners are now on the stocks. At Parrsboro four schooners, a barquentine and a tug are being built.

The steamer Midland Queen, which was recently brought to the lakes from England, had to go to drydock at Detroit for repairs to her hull, that will cost $20,000. The Midland Queen grounded on a rock in the Soo canal, and about 24 plates had to be removed. The steamer is owned by Jas. Playfair & Co., Midland, Ont.

The first of five submarine boats of the Holland type, being built at Barrow-in-Furness for the British Government, has been launched. The other four are to be ready this season. They are 63 feet long, and their greatest diameter is 11 feet. They are fitted with gas engines for surface running, and motors with storage batteries for submarine runs. They cost about $175,000 each.

The steamer Richelieu sank in 100 feet of water, near Kingston, on 2nd Oct., by the shifting of her cargo in a rough sea. She is the second steamer lost by the Lake Ontario and Bay of Quinte Steamboat Co. this season, the Hero having been burned. The Richelieu was built at Montreal in 1845, and has an iron hull. She has since been raised.

The 20-foot channel in Collingwood harbor has been completed.

Nansen, of farthest north fame, approves of Capt. Bernier's proposed method of reaching the North Pole.

It is announced that St. John, N.B., will be the winter port for the Elder-Dempster steamships this season.

The Canadian Pacific Railway Co. has decided to run the steamships Tartar and Athenian regularly between Vancouver and Hong Kong.

McLachlan Bros., of Arnprior, have placed a new steamer, the Pontiac, on Chats lake. At her trial trip she developed a speed of 12 miles per hour.

The Vulture, another British torpedo boat destroyer, has showed weakness of construction. She buckled while under steam and had to be laid up for repairs.

The contract for a new Government steamer for use for the planting and protection of oysters in the Maritime Provinces has been awarded to Burrell and Johnson, shipbuilders, Yarmouth, N.S.

The schooner Helen M. Gould, recently burned at North Sydney, C.B., was the finest fishing vessel afloat. She was lighted by electricity, and had an auxiliary gasoline engine. She hailed from Gloucester, Mass.

Peter Nissen has been taking soundings in the Niagara gorge with his odd little boat the Fool Killer, in which he made a successful trip through the whirlpool rapids. He has established the fact that there are undertow currents of terrific force.

The Duke of Cornwall and York says that the R. & O. steamer Kingston, which conveyed the Royal party from Kingston to Brockville, is the finest he has seen since leaving England, and that the accommodation on board exceeds that on his own yacht.

The R. & O. Navigation Co. has done so well this season that it will, as rapidly as possible, replace all its old steamers with modern boats of the Toronto, Kingston and Quebec type. An order for another boat will be given as soon as the Quebec is launched.

The steamer Goddard, built at Bennett in 1898, is reported to have capsized during a squall on Lake Le Barge, and three lives lost, one of them being the captain. C. E. McDonald, who built the river steamer Angeline at Lake Teslin, and was the first to navigate the Hootalinqua to the Yukon.

Captain Berner, the arctic explorer, has been interviewing the Government in regard to winter navigation. The people of Quebec want him to demonstrate the feasibility of winter navigation to Quebec, and he thinks the Government might be induced to loan one of the vessels which run between Prince Edward Island and the mainland for the purpose.

Sir Christopher Furness, who has been visiting the steel and other works in Nova Scotia, says the money for a fast Atlantic steamship service is ready in England as soon as certain points, such as insurance, etc., are settled. He expressed himself much pleased with the industrial outlook in the Eastern provinces, and after his visit there went to Algoma to inspect the Clergue industries.

Mining Matters.

A wire tramway has been erected at Alberni on the Hayes property. This is the first to be installed on Vancouver Island.

One of the richest gold milling strikes on record has been made at Pine Creek, Athn. A. C. Irvine, the owner is arranging for capital to work it.

The Dominion Coal Company intends it is said, to reopen the old Victoria mines at Cape Breton, and give work to an additional 500 men. The company has already dredged [illegible] to the St. Lawrence.

Natural gas has been struck on the farm of F. J. Noxon near Bloomfield, Ont.

Another valuable corundum deposit is said to have been found at Combermere.

The Port Hope Natural Gas and Oil Co. have struck good flow of gas at a depth of 570 feet.

Canada imported last year 23,000 tons of coal from England, and 4,307,000 tons from the United States.

A Government diamond drill has been sent to Eganville to test the iron deposit of the Canada Iron Furnace Co.

The Citizens Gas Co. at Port Colborne have struck a gas well with a capacity of 250,000 feet per day. Two others are under way.

Fred Folger, of Kingston, announces that he has found a vein of molybdenite in Miller township, county of Frontenac.

The Intercolonial Copper Company at Dorchester expect to have their reduction works in full operation in the course of two or three weeks.

Mr. Lee, of Madoc, has sold his interest in the Sumallee iron mine to Mr. Riggs, of Belleville. The property has been optioned to a Buffalo Company.

Dr. King, of Windsor, managing director of the United Gas and Oil Co., says he believes the entire natural gas supply of Essex will be exhausted before Christmas.

At the Memramcook, N.B., oil fields, two wells have been sunk to a depth of four hundred feet, and one is being pumped with fair results. Two more wells are down a hundred feet.

A new gold dredger which has been under test at Kamloops has given great satisfaction. It will operate upon the gravel of the North Thompson river in which much gold is known to exist.

Capitalists connected with the Amalgamated Copper Company have bought a valuable property at Desbarats, and are about to build a smelter either at Little Current, Thessalon or Desbarats.

The Fraser River Gold Dredging Company, Ltd., is licensed to carry on business in British Columbia. The head office is in England, and the capital of the company is £25,000. The head office in British Columbia is at Lytton.

Iron ore has been found on a number of islands in Hudson Bay, off the coast of Ungava. Coal has also been found. Hudson Bay is not as far from Toronto as Port Arthur, and a railway would make these deposits available.

The Manitoba Union Mining Co., which was expected to work some gold mines in the New Klondike district of New Ontario, has been devoting its energies to the development of cement and gypsum deposits, the former near Miami, Man., the latter on the shores of Lake Manitoba.

Contractors on Le Roi mining properties at Rossland having been fined for breaches of the alien labor law, they have retaliated by bringing actions for damages against the labor unions for losses caused by strikes. The actions are based on a recent decision of the House of Lords.

The American Consul-General at Montreal has sent to his Government a report on the corundum deposits of Canada, of which he speaks very highly. The corundum at Combermere is 95 per cent. pure whereas manufacturers have heretofore been satisfied with an 80 per cent article.

Belmont Gold Mine will put in a 700 h.p. air compressor of the best English make. Work has already begun in erecting the power house and building flumes. The air will be conveyed in 11 inch pipes a distance of nearly two miles to the mine. Mr. Stubles, an English expert, has been on a visit to the mine. His opinion as to its richness agrees with that of Mr. Hill, the company's expert.

At Sudbury there is much activity. Some 2,000 men are employed by the refining companies. The Canadian Copper Company is smelting 1,600 tons per day of copper and nickel ore into matte, which is handed over to the Orford Copper Company which, at the Ontario Smelting Works, further treats the product until it is brought to an 80 per cent matte. This is then shipped to the latter company's refinery at Constable Hook, New Jersey, where the copper and nickel are separated and refined. The last is the most expensive process of all.

The assay office at Vancouver is giving satisfaction. The Cariboo Hydraulic Mines recently made three shipments of the value of approximately $17,000 each to Vancouver, New York and San Francisco for assay. There was a loss of 13 ounces on the New York shipment, or $300 worth, as compared with the Vancouver office. No return has been received from San Francisco. A crusher has been added to the plant at the Vancouver office in order to pulverize the solid residue left in the flux after the gold has been melted. The material so crushed will be washed in order to extract any particles of gold which may be disseminated throughout the flux. By this means it is hoped to reduce the loss of gold in melting to the lowest possible minimum.

Railway Matters.

The Canadian Northern railway has adopted the 24-hour system.

The C.P.R., which employs over 28,000 men, has put aside $250,000 for a pension fund.

It is stated in Kingston that the C.P.R. will this fall bring to that city 20,000 tons of coal for use on their lines.

The Pontiac and Pacific line, under construction between Aylmer and Hull, is about completed. A new $7,000 station has been built at Hull.

Work on two new bridges over the Red River at Winnipeg is nearly completed, one for the Canadian Northern railway, and one for the C.P.R.

Nearly 1,000 men are employed on the construction of the Republic & Grand Forks railway, connecting Grand Forks with the well known Colville reservation mining camp, B.C.

The Hastings Mill Company is building a railway from Rock Bay to Salmon River, B.C., It will tap extensive timber limits, and when the lumber is exhausted it will be used for freight and passengers.

A new bridge, replacing the old tubular girder bridge, has been built at Etchemin, Que., and two new bridges are being built at Causapscal and Millstream on the Intercolonial Railway.

C J. Booth, G. W. Mitchell, Claude McLaughlin, W. Anderson, J. A. Seybold and J. F. Booth were elected directors of the Canada Atlantic Railway Co., at its last annual meeting.

It is stated that United States capitalists, including the Vanderbilts, have a scheme on foot to build another transcontinental road to compete with the C.P.R. It is not generally credited.

The Canadian Northern railway has decided to build a branch to Ely, giving connection with the Duluth & Iron Range road, and the system of the United States. It will be 45 miles long.

The Royal party was so pleased with the comfort and convenience of the train provided for their tour through Canada that there is a possibility of its being sent to England for Royal use there.

D. H. Riordan, president of the Brandon and Northwestern railway, has been committed for trial on a charge of defrauding Samuel Johnston of $400 cash and $1,600 in notes. It is alleged that he let a contract to Johnston to build 100 miles of railway, for which he had no charter.

The Canadian Pacific is to build a new steamship for their Empress line, acquire fourteen steamers of the Canadian Pacific Navigation Co., build a new boat for the Vancouver-Victoria route and a new upper lake boat of 1,800 tons. Bonds for £480,000 will be issued to defray the cost.

The Midland railway, connecting Truro with Windsor, is completed, and trains will be running in a few days. This makes the fourth line of railway radiating from Truro. The North Colchester railway from Truro to Brule, whence steamer communication will be established with Charlottetown, P.E.I.; the Truro and Parrsboro railway, and the Stewiacke Valley railway, are all likely to be built in the near future.

The N. S. Midland railway will build workshops at Truro.

The Carman branch of the Canadian Northern railway is to be continued to Somerset.

The survey of the K. & P. Ry. from Sharbot Lake to Carleton Place has been completed.

It is said the C.P.R. may build a shorter line across East Kootenay. Engineers are now locating a line along the St. Mary's River.

The Ontario Government has decided to build a railway from North Bay northward towards James' Bay. The work will be proceeded with next season.

A total of 292,000 cars went through the St. Clair tunnel last year. The average was 26,000 a month, and in some months the number reached 33,000.

A survey party is at work locating the route of the new C.P.R. branch running northwest from Moosomin, Assa.

J. Armstrong, locating engineer for Mackenzie, Mann & Co., is exploring the country between Edmonton and Prince Albert.

The Canadian Pacific will build at its own shops 177 flat cars of 60,000 lbs. capacity, 275 box cars of 60,000 lbs. capacity, and 300 box cars of 80,000 lbs. capacity.

A contract has been signed for a branch of the Great Northern railway between St. Catherines, Que., and Garneau Junction.

Power will be asked at the next session of the Dominion Parliament to build an extension of the Manitoulin & North Shore railway from Wiarton to Goderich, a distance of 60 miles.

The C.P.R. has fitted up two cars with Tretheway's automatic pipe coupler with a view of testing it. The inventor is a Vancouver man. The cars have come across the continent, and the invention seems to work well.

A railway from Kitimat to Hazelton in Northern British Columbia is in contemplation. The distance is 110 miles. It would open up extensive coal and ore fields along the Skeena.

E. C. Hawkins, who recently resigned the office of president of the White Pass & Yukon Railway Company, is arranging for the building of the Klondike Mines railway, from Klondike City, a suburb of Dawson, to the mines on Eldorado, Bonanza and Dominion creeks. It will be a steam road with provision for converting it to electricity.

Judgment was given recently in the Court of Appeal in the case of the New York & Ottawa Co. vs. Collins Bay Rafting & Forwarding Co. This was a case growing out of the wreck of the railway bridge across the south channel at Cornwall about three years ago. Captain Leslie of the Wrecking Co. undertook to remove the two wrecked spans, for $25,000, contracting to have the work done by the fall of 1899. He took out the shore span, piecemeal, but attempted to take out the centre span whole and failed. At the trial the Wrecking Company was adjudged $10,000 for the work done on the first span. The case was appealed and the court sustained the appeal, which leaves Leslie with nothing for all his difficult work and a bill of costs to pay besides.

At its regular meeting in Montreal, on Oct. 24th, the Canadian Society of Civil Engineers listened to a very instructive paper by W. W. Colpitts, M.Sc., on the "Economics of Railway Improvements." Mr. Colpitts defined civil engineering as "the art of making a dollar earn the most interest," and showed that failure to keep this end in view in railway construction, whether by building a line so expensive that it could not pay interest, or so cheap that the operating expenses were excessive, frequently resulted in the appointment of a receiver. When the traffic on a line has developed sufficiently to warrant improvements, it is generally better to reduce grades than to double the track. A reduction of grades from 1 to 4 per cent. makes it possible to have freight trains twice as long, and so reduces operating expenses about 25 per cent. Mr. Colpitts went very fully into the questions of curves, ruling and virtual grades, etc., and gave several tables and plotted curves for making all the necessary calculations in regard to them. The subject will be discussed at the next meeting.

The C.P.R. is carrying wheat to the Fort William elevators at the rate of 350,000 bushels a day.

The Brockville and Westport railway is being improved. A new engine house is to be built at Westport.

A standard box car for the railroads of the United States, Canada and Mexico has been adopted at the semi-annual meeting of the American Railway Association. The car is 36 feet long, 8 feet 6 inches wide and 8 feet high, inside measurement, making a cross section of 68 square feet, the car having a capacity of 2,448 cubic feet. Side openings to be 6 feet wide. The committee has been at work on the matter two and a half years.

The Canadian Pacific Railway proposes to build a branch from Dinorwic, a station east of Wabigoon, in the Rainy River district, northward toward Lac Seul, on the Keewatin boundary, for a distance of 21 miles, providing the Ontario Government will make such improvements in the navigation of Lac Seul and Lake Minnietakie as would provide continuous navigation between these two lakes. They also propose to build a line north in the Thunder Bay district to tap the great clay belt of 16,000,000 acres which runs east and west for hundreds of miles in northern Ontario. Explorations by the company's engineers have been made, but the line examined would be too expensive of construction and further explorations are to be made the coming winter. A. W. Campbell, Deputy Minister of Public Works, is examining the Lac Seul country on behalf of the Government.

Dr. Seward Webb, of New York, and party, have been in Cape Breton, and there is considerable speculation as to their object. In an interview at Sydney he said: "Sydney or Louisburg will eventually be the terminus of a fast Atlantic passenger steamship line. There is no doubt about it. The question of a short voyage is solved." When asked if his company would establish such a service, Dr. Webb replied: "It is difficult to say just now what we will do in that direction; we are feeling our way along, so to speak, and may do considerable within a few years. We will probably build a road from Mulgrave to Halifax on the completion of the Cape Breton extension, and also acquire or build another along the south shore of Nova Scotia, in order to give us connection with the D. A. Railway Steamship line to Boston at Yarmouth. These lines, however, would be built chiefly for commercial and tourist travel, and would probably have little connection with the fast Atlantic service."

Personal.

E. F. Braden, of the firm of Braden Bros., plumbers, Victoria, is dead.

Robert Harrison, an old employee of the Bertram Engine Works Co., of Toronto, is dead.

Alfred Gardner, of the Eureka Paving Co., Toronto, and a well known contractor, is dead.

Chas. R. Stotesbury, at one time head of the Furness waterworks system in Toronto, is dead.

Patrick Hussey, formerly an engineer on the Grand Trunk between Brockville and Belleville, was killed in an accident in Arizona.

Engineer John Robertson, of Niagara Falls, was so injured in a collision at Harrisburg that he had to have his leg amputated.

Prof. Hand, the well known fireworks manufacturer, of Hamilton, was fatally injured by an explosion in his factory on the 11th of October.

A. N. McLennan, superintendent of the Sydney & Louisburg railway has resigned. F. C. Kimber, of the traffic department, has also resigned.

W. H. Browne has sent in his resignation as general manager of the Royal Electric Co. This is the result of the recent amalgamation with the gas interest of Montreal. H. S. Holt is general manager, with P. G. Gossler in charge of the electrical department.

Thos. White, chief engineer of the Canadian Northern railway, was married, at Port Arthur on the 14th of October, to the widow of the late Thos. Marks.

Lieut. Sherwood, of the Royal Military College staff, Kingston, has resigned to become assistant superintendent and consulting engineer for a large mining company in California.

Frederick Glebe, proprietor of Acton roller mills, was killed by a train on the G.T.R. on Oct 5. He had the day before completed the sale of his mills to Beardmore & Co., Toronto.

W. S. Kinnear, of Detroit, assistant chief engineer of the Michigan Central railway, has been appointed assistant superintendent of the Canada Southern division, with headquarters at St. Thomas.

Charles M. Hays, formerly general manager of the Grand Trunk and latterly president of the Southern Pacific, has resigned. It is said he has been offered the presidency of the Chicago and Erie.

Homer Pringle, formerly superintendent of the Canada Mutual Telegraph Co., and of the Canadian Pacific Telegraph Co., was asphyxiated by escaping gas in his boarding house at Toronto on Oct. 5th.

Sir Christopher Furness, head of the great Furness line of steamships, and one of the leading men in the British steel industry, is making a tour of the ship-building yards, and steel, iron, and coal industries of Canada.

Henry Holgate, C.E., Toronto, and Robt. A. Ross, E.E., Montreal, have formed a partnership, under the style of Ross & Holgate, with offices in both cities. They will make a specialty of water power developments and steam and electrical plants.

C. J. Crowley, C.E., who has filled many positions on the Grand Trunk, has been appointed resident engineer and superintendent of bridges and construction on the division between Detroit and Chicago, with headquarters at the former city.

Consulting Engineer C. Baillarge and his son, W. D. Baillarge, acting city engineer of Quebec, have been on a visit to Buffalo and other cities, to ascertain the cost and efficiency of electric light, in connection with a new contract for lighting Quebec.

Thos. Williams, who has been promoted from superintendent of the Ontario Division of the C.P.R. to the position of general superintendent of the Lake Superior division, was banqueted at London.

George Bickell, formerly with Messrs. McLaren and Bate, Montreal, now chief draughtsman for the Holtzer-Cabot Co., Brookline, Mass., married a short time ago, was presented with a handsome sideboard by the employees. Mr. Bickell formerly lived in Quebec city.

Harvey V. Higgins, general manager of the Standard Tool Co., manufacturers of twist drills, reamers, etc., Cleveland and New York, has returned from a five months' trip throughout Europe in the interests of his company, and states it has resulted in very successful business.

Charles P. Nolda's many friends in Quebec and Montreal will be pleased to hear of his promotion to be cashier of Jenkins Bros', Boston branch. He had been for some years a member of this firm's office staff in the head office at New York, and by ability solely secured this important position.

W. A. Plunketts, second assistant engineer on the United States transport Hancock, the largest of the fleet engaged carrying troops between San Francisco and the Philippines, is on a visit to Canada. He is an old Brockville boy. He will rejoin his ship at New York.

Harry Guess, graduate of the Kingston Mining School, superintendent of the Ottawa Gold Mining Company's plant at Keewatin, and manager of the Sakoose gold mine in the Rainy River District, has resigned these positions to accept the managership of a cyanide plant at Silverton, Col., at a handsome salary.

Fred. W. Martin, eldest son of Patrol-Sergeant Martin, and superintendent of the Hamilton Electric Light and Power Company, has been appointed manager of the Lincoln Electric Light and Power Company, with headquarters at St. Catharines. He was presented with a gold watch and chain, by his former employers, on leaving.

Miscellaneous Notes.

The Boundary, B.C., mines are prospering. The Granby smelter's record of 4,600 tons in seven days breaks all former records.

A seam of coal about four feet thick has been found on the banks of Shell river, about five miles from Prince Albert, N.W.T.

A new compressor plant is being installed at the Granite Poorman mine, B.C., and as soon as completed the Poorman will resume operations.

A by-law to raise money to construct waterworks in Shawville, Que., was defeated by 32 to 17. Scarcely half the vote was polled.

The large central span of 306 feet has been placed in position at the Interprovincial bridge across the Ottawa at Portage du Fort.

A three foot seam of good coal is said to have been found on the shore of English Bay, Vancouver. If coal exists there it will make Vancouver a great industrial centre.

Peterboro is to have another roller flour mill. The building will be four stories high, of brick, with foundations of Longford stone. The capacity will be from 150 to 200 barrels per day.

The site for the new Mint building in Ottawa has been staked out, on Nepean Point, near the Government printing office. The building will be 165 feet by 187, and it is intended to make it such a structure as shall add to the beauty of Ottawa.

Negotiations are going on between J. R. Booth and the Buffalo contractors who built the Standard Elevator Company's new elevators at Buffalo, for the erection of new elevators at Depot Harbor and Quebec. They will be of the newest pattern of Standard elevators.

A machine for track laying is now in use on the Canadian Northern railway, the invention of Hugh Mann, of Mackenzie, Mann & Co. It was built at the C. N. R. shops at Winnipeg. It is said it will do the work of 100 men, or lay one mile of track per hour, and costs only about $4,000.

Geo. Reid & Co., 11 and 13 Front street east, Toronto, have been appointed Canadian agents for the firm of Henry F. Cockill & Sons Ltd., makers of the celebrated "stretchless" leather belting, which is placed on the market as one of the latest developments in the manufacture of leather belting.

Frederick Welker, Vancouver; William Welker, Montreal, and Joshua Collitt Rose; William S. Laflamme and Alexander S. McCormick, Westmount, are applying for incorporation, under the name of the Imperial Syrup Company; to manufacture syrups, preserves, etc., with headquarters in Montreal.

An application to the Dominion Government for incorporation is made by C. F. Sise, Hon. R. McKay, Robt. Archer Hugh Paton and Chas Cassils, as the Dominion Subway Co. It is virtually the Bell Telephone Co., and if a charter is granted they will have power to construct subways in any city in Canada.

A machine has been introduced into the salmon canneries in British Columbia, which may settle the Chinese immigration question. The machine cuts the fish to right lengths, packs the cans and tops them, doing the work of 40 Chinamen. The Chinese, however, are still employed in soldering the tins and cooking the fish, etc., where they can be had, but they refuse to go where a machine is, and have walked out of a number of factories.

The council of the Montreal Board of Trade has accepted an offer for the erection of a new building on the same site as the one destroyed by fire. Peter Lyall & Son are the contractors. It is intended to construct a fire-proof building, with Indiana stone fronts. The foundations of the building now in ruins will be followed very closely, and the new building will have the same number of stories, and be about the same height as the old one. It is to be ready for occupation by May 1, 1903.

The Imperial Varnish Co., Toronto, are extending their works.

The Acton, Ont., Tanning Co. is about to enlarge its works.

Another story and third elevator are being added to the Temple Building, Toronto.

The Sarnia Gas & Electric Light Co. is extending its gas mains to Point Edward.

A by-law to bonus the Hamburg Brass Mnfg. Co. was carried at New Hamburg, Ontario.

Goderich ratepayers have voted a bonus of $10,000 to a summer hotel, to accommodate 200 guests.

A by-law to give a bonus of $2,500 to J. C. Mundell & Co., furniture manufacturers, has been carried at Elora.

Tilsonburg has offered Shurly & Dietrich, of Galt, $10,000 to establish a factory for the manufacture of harvest tools.

Christie, Brown & Co., are putting an addition to their biscuit factory, Toronto, 80 x 185 feet, at a cost of about $50,000.

The Michigan Land & Lumber Co. has acquired the mill and franchise of the Blind River Lumber Co., and has renovated and extended the premises.

As a result of a 12 days run of the 20-stamp mill at the Mikado 405 ounces of gold were recovered. It is stated that the cost of mining and milling are about $2.70 per ton. As work proceeds rich bodies of ore are being opened up.

An oil and gas well has been struck at Wheatley at a depth of 1,100 feet. When the pocket was struck a stream of oil was forced 50 feet into the air. A cap has been fitted and the flow controlled. Experts claim that the quality of the oil is superior, and they say it can be put on the market as first-class lubricating oil without refining. The capacity of the well is 50 barrels daily.

Armstrong Bros'. Tool Co., of Chicago, have just received an order for Armstrong tool holders from the Mexican Central Railway Company, Ltd. After placing several small orders with them for tool holders of various kinds, with which they have had more than a year's experience, giving them ample opportunity to judge of their merits and economy as compared with the solid forged tools, the railway company has now sent their order for over 200 tool holders, mostly of heavy sizes, and a large quantity of steel for use in same, the order amounting to over $1,000.

The Toronto Paper Co. has just completed the tallest chimney in Cornwall. It is 133 feet high, with a concrete foundation, 6 feet deep. At the base it is 16 feet square and at the top 8 feet 9 inches, with a graceful capital surmounted by an iron cap weighing 2,200 pounds. There are from 180,000 to 200,000 bricks in the stack. It is built on a new principle. The centre core is circular, and runs up to about 50 feet from the top, being detached from the outside shell, to avoid vibration. The core is lined with fire brick about 40 feet up and an iron ladder reaches from the base to the top inside. The chimney was built by J. C. Johnstone.

The American Steam Gauge & Valve Manufacturing Company, Boston, Mass., the well known manufacturers of steam gauges, pop safety valves, Thompson indicators and engine and boiler fittings, have been awarded a gold medal at the Pan-American Exposition. Visitors to the Exposition will, no doubt, remember the display of this house, as it attracted general attention. Their steam gauges and engine fittings which won for them this medal are equal to any and superior to many products of similar houses, and their numerous patrons in this country and the United States will congratulate them upon the honors they have carried off.

For a year or more J. J. Hill, of the Great Northern, has been making efforts to ascertain if iron ore of Bessemer quality exists on the Pacific coast in sufficient quantities to permit the development of an iron and steel industry on a large scale. It is said he has been successful in finding what he wants in the Fort Steele district of British Columbia. Numerous ledges have been found, of which nine are of immense size, running as much as sixty feet in width. At Bull river men have uncovered great masses of hematite lying exposed on the side of a mountain, three ledges being uncovered, one sixty feet wide. The surface indications show that another ledge extends 21,000 feet.

Above is shown a facsimile of the certificate accompanying the gold medal awarded to the Canada Foundry Co., of Toronto, by the directors of the Toronto Industrial Exhibition, for their very comprehensive exhibit, which was illustrated in our September number. An interesting feature of the medal is that it bears on its face the words: "In Commemoration of the Accession of Edward VII., Rex et Imperator, 1901." It was of course necessary to make a special die for this year's issue of medals, but by doing so they are distinct from every other issue, thus giving them an enhanced value in the eyes of the fortunate recipients.

CHEMICAL AND BACTERIAL TREATMENT OF SEWAGE.

Editor, Canadian Engineer:—

Sir,—I have observed that in many of the articles on Sewage Disposal which from time to time appear in your valuable paper, the writers have a tendency to underrate the value of the chemical treatment, and to boom up the purely biological method. Mr. Douglas Archibald, in a paper read before the Sanitary Institute, in England, has this to say about contact filters at Leeds, England: "The rapidity with which they have been found to sludge up when dealing with crude sewage delivered without previous tank sedimetation or septic tank treatment has dealt a death blow to the general acceptation of the Sutton system inaugurated by Mr. Dibden, etc." In a very well written paper he shows conclusively that as good or better effluent can be obtained by adequate chemical treatment, followed by a single contact filter, than with septic tank followed by several contact filters. As a matter of fact, the sludge that was supposed to be got rid of by the biological plans still remained to a large extent, and was in a condition difficult to deal with and most offensive. He thus concludes his paper: "It would seem, therefore, from every point of view that before a blind rush is made into bacterial systems and chemicals are relegated to a back shelf, a careful investigation should be made of what appears to be a happy combination of chemistry and bacteriology in which each science is made to contribute towards the total result exactly that component in which it is able to work to the greatest advantage." Recent experience has shown that the septic tank and coarse filters do not get rid of the sludge as was at first expected.

Ernest G Barrow,
Chief Engineer, Sewage Disposal Works.
Hamilton, October 5th.

CANADIAN MUNICIPAL CONVENTION.

A convention of delegates interested in municipal government was recently held in Toronto, on the invitation of Mayor Howland. About fifty delegates were present, representing five provinces, and an organization was effected, under the title of the Union of Canadian Municipalities. This organization will serve a useful purpose in bringing united pressure to bear towards securing such legislation as shall be in the interest of the municipalities. Among the subjects discussed, and which crystalized into resolutions, affirming the principles therein contained, were: A careful oversight of all concessions of franchises in view of the future extension of municipal ownership, especially in connection with electric railways; the full and exclusive control of their streets by municipalities; that all legislation, under which properties of corporations are assessed, as scrap iron, should be repealed; protesting against the jurisdiction claimed by the Railway Committee of the Privy Council to order municipalities to pay part of the cost of the protection of crossings and of bridges and subways; recommending the planting of forest trees on streets, parks, and side line roads. A proposal that legislation should be sought, in view of the high price of coal, to enable municipalities to supply their citizens with coal, was voted down. The advocates of the proposal took the ground that coal was as much a necessity as water or gas, and that Glasgow was establishing a municipal coal yard; but on the other hand, it was argued that if the price was too high, anyone could go into the business and sell cheaper. The object of the association, as organized, is the general improvement of every branch of municipal administration. Annual conventions will be held. Mayor Howland, of Toronto, was elected president.

About $140,000 has been spent by the Ontario Government on colonization roads this season.

THE SANITARY DRAINAGE OF HOUSES AND TOWNS

By H. G. Tyrrell, C.E., Boston, Mass.

The science of sanitary engineering is of late origin, so late indeed, that the men who formulated it are still young. Not till the middle of the present century did the people become awakened to the fact that their lives were to a great extent in their own hands, and that the majority of deaths which occur might have been avoided. Baldwin Latham says, "If the air of heaven is vitiated, the water rendered impure, or our food improper or insufficient, the body is robbed of its life giving element, and soon succumbs to disease and death. It is the true aim of the sanitary engineer to assist nature in her great but simple operations, to facilitate the purification of air, to prevent dangerous impurities entering our supply of water, to supply an abundance of these life-giving elements, to remove as speedily as possible, before decomposition commences, all those matters eliminated from the animal system, together with all the decomposed refuse."

The question of sanitary drainage is essentially one of life. Mr. Stephen Smith tells us that "Man is born to health and longevity; disease is abnormal, and death, except from old age, is accidental, and both are preventible by human agencies." But no sooner does a human being come to live in one place than the danger from decomposing refuse begins. As hamlets increase to villages, and these again to towns and cities, the danger expands and becomes greater. Henoe, from the very first it is all important that the greatest attention should be paid to the sanitary drainage of the place.

Perhaps the most effective way of impressing the necessity of pure air, pure water and a pure soil is by citing a few examples. In twenty-two years continued war on the continent, England sustained a loss of 79,700 men, but in one year of cholera her loss was 144,800. In the British army in 1779, before the improved sanitary appliance had been furnished, the death rate was one in forty-two, and those sick, two in five of able bodied, picked men. In 1813, after a more perfect system had been provided, the death rate was one in one hundred and forty-three, and sick, one in twenty-one. And coming nearer home, to our home and country, we saw during the summer of 1886, in our sister city of Montreal, more deaths occur in a single week from smallpox, than happened in the whole Canadian continent in the Boer war. Yet while with the latter the whole country is concerned and terribly excited, the former passed almost unnoticed and will probably in a few years be almost forgotten.

Another most striking example of the effect of poor drainage is furnished by the Maplewood Ladies' College in Pittsburg, Mass., where an epidemic of smallpox occurred a few years ago. The people were of course wonderfully alarmed, but in the report of the examination of the premises, Dr. Palmer says, "Before the investigation the matter was spoken of as an act of an All-Wise Providence, to Whose ruling all must submit. Looking with the eyes of science upon the over-flowing cesspools and reeking sewers as inevitable causes, and with the eye of humanity upon the interested and innocent victims languishing in pain and peril or mouldering in the shroud, I could but regard such implication for Providence, though perhaps sincerely made, as next to blasphemy, especially when uttered by the agents who were to be held responsible. The prayer of charity might have been, 'Father, forgive them for they know not what they do.'"

DRAINAGE OF HOUSES.

The final object of any system of sewers, however elaborate or complicated, is the drainage of our dwellings. In order that this drainage may be complete, the following requirements must be kept in view: (1) That the foundation soil be dry and free from dampness; (2) that all liquid and excremental waste be safely and quickly conveyed beyond the limits of our dwellings; (3) that a constant supply of pure air be admitted to the dwelling; (4) that nothing be allowed to collect about the house which would taint the air or render the atmosphere impure; (5) That proper arrangements be made to prevent the entrance of sewer gas through traps or other fixtures.

The first of these requirements, that the subsoil be free from moisture, is of great importance. If the basement or cellar is always damp, and gases are continually rising through the house, it is impossible that the inhabitants should be hale and strong. If the foundation soil be of gravel or sand no other drainage will be necessary. But where clay occurs, as is usually the case, a two-inch drain all round just inside the wall and about a foot or so from it will be necessary. Similar ones must be put at distances of about fifteen feet apart. To prevent the exhalation of moisture which rises even from the driest soil, a coat of some impervious substance, such as concrete, asphalt or hydraulic cement should be spread.

Perhaps the most difficult of all the connection is the arranging of pipes and fixtures for the removal of waste. If the pipes are of lead their durability will be much increased by giving them a thick coat of paint inside. When thus protected and well ventilated they should last from twenty to thirty years. Iron pipes are sometimes preferred. They are usually screwed together, and have the advantage of being strong enough to support their own weight with the help of straps. Around the joints rings are sometimes put spherical in form, so that a slight settling of the pipes will not break the connection. A 4 inch pipe is amply sufficient to carry away all the refuse from an ordinary dwelling.

The essential features in the arranging of water closets, sinks, etc., are: (1) Extension of all soil and waste pipes through and above the roof; (2) providing a fresh air inlet in the drain at the foot of the soil and waste pipe system; (3) trapping the main drain outside of the fresh air inlet; (4) providing each fixture as near as possible to it with a self-cleansing trap safe against syphonage and back pressure; (5) to provide vent pipes to such trap under-fixtures as are liable to be emptied by syphonage.

Thus by having a ventilation at both ends of the soil pipe we prevent the accumulation of foul gases, which if the metal be lead, would very soon succeed in destroying the pipe. Without this ventilation traps are always liable to be forced or syphoned, owing to the force of tides or winds at the mouth of sewers, or to a change of temperature. But while the fresh air inlet at the foot of the soil pipe was beneficial as a ventilator it would become obnoxious on account of the emanation of gas. Where the pipe is a waste from the kitchen sink a grease trap should be placed, the nearer the walls the better, that it may catch all the oily matter before it hardens in the pipe. One of brick, about four feet in diameter, with the pipes arranged to syphon it out will answer. If the catching of the grease is not the object a flush tank may be substituted. Field's tank is the commonest, and probably the best. It is of course only for liquid waste. When the tank becomes filled, one more flow of water into it starts the syphon acting, which empties the tank nearly to the bottom. An economical way of disposing of such slops is to carry them by means of a series of pipes laid with open joints underneath the garden or lawn. In this way our front lawn is always kept beautifully green. It will be necessary to state that before entering the open drains the waste passes through a flush tank. By this arrangement the discharge is made intermittent, so that the flow of waste being more copious, saturates the ground to a greater distance.

The water closet is of all the plumbing arrangements probably the most troublesome. It would be well if they were built separate altogether from the house, but as this would to a great extent destroy their convenience, they may instead be separated from the rooms by a ventilated lobby or double doors. It should always have an outside window, and never should the vicious plan be adopted of having them off a bedroom. The old pan closet has little to recommend it but its general adoption. Its "inner chamber of horrors" is a generating place for foul and poisonous gases, which after being absorbed by the sealing water are given off into the room. The Jennings patent has the advantage of a tight valve as well as a double waste seal, all the water for each flushing is under the seat, so that defections falling into it are immediately disinfected. Many sanitary authorities still prefer the simple hopper closet, since its only trap is always in sight. Where an intermittent supply of about fifteen minutes is provided it is perhaps the safest. Many other modifications of these have been made, more for the sake of a new patent than to introduce an improvement.

DRAINAGE OF TOWNS.

Originally sewers were for the purpose of surface drainage only. It was at that time illegal to discharge house refuse or other foul matter into them. In 1847 in England this idea seemed to be reversed, and by Act of Parliament it became compulsory for all drainage in cities and towns to be discharged into the public sewers. As the science of sewering now stands, the principal objects are that the pipes be perfectly tight, that they are of the proper size and arranged at a suitable fall, and that means be provided for their flushing and ventilation.

In starting the work of draining a town, whether it is intended to finish it at once or not, a plan showing the complete system should be drawn so that when it is ended the arrangement will be in accordance with the original design. It is almost needless to say that a system of sewers should be perfectly tight from end to end. If they allow foul liquids and gases to permeate the ground they are no better than the vault or cesspool.

The fall or incline of sewers is also of great importance. Adams gives the following table on calculation and observation for the size of sewers running either full or half full: For 6-inch pipe a grade of 1 in 60; 9-inch, 1 in 90; 12-inch, 1 in 200; 15-inch, 1 in 250; 18-inch, 1 in 300; 24-inch, 1 in 400; 30-inch, 1 in 500; 36-inch, 1 in 700; 48-inch, 1 in 800.

When the direction changes, the friction increases, and the fall must be increased to compensate for this. When the lay of the land will permit it, the most rapid fall should be given at the upper end of the sewer, where the quantity of water is least, and consequently where the velocity is needed to secure the flow. Mr. McKenzie, an experienced sanitary engineer from London, England, quotes an instance in which the level of the sewer being out from 1-16 to ⅛ in. had to be removed. The fall in this case is very small, being only seven inches in a mile: It had, he said, been laid down but 24 hours, and the cement was then harder than the brick. If the amount of water flowing is proportional to the size of the conduit, sewers of different size give the same velocity at different inclinations; for instance, a ten foot with a fall of two feet per mile, a five foot with a fall of four feet per mile, a two foot with a fall of ten feet per mile, and a one foot with a fall of twenty feet per mile, will have the same velocity, but the ten foot sewer will require one hundred times as much sewage as will the one foot sewer, and unless it carries a volume of water proportional to its capacity the velocity of its stream will be correspondingly lessened. It becomes, therefore, especially important that the size of the conduit be adjusted to the volume of the stream. When half full and when full the velocity is the same, and when a little more than three-quarters full the velocity is greatest. In determining the size of a sewer it is necessary to consider not only its fall, but also the amount of rainfall and sewage which it is required to carry away. The commonest of all defects in sewers is that expensive one, being too large. It is much better to have occasional repair due to excessive rainfalls, than to allow for extraordinary cases. The invariable result of making the sewer too large is that a sediment forms in the bottom, and before long they are clogged with filth, only a small orifice large enough for the ordinary flow remaining, whereas, had they been of the proper size they would have by their own flow been kept clean, and would have received a much greater rainfall than the larger but choked sewer.

In small towns and villages it is not usual to allow for greater rainfall than ¼-inch per hour In cities where the area is mostly built and the water can more easily find its way to the sewer a fall of ½ inch per hour is allowed. Even in populous towns and cities a considerable quantity of water will not reach the sewer, but will soak into the ground or evaporate Allowing that a fall of ½ inch per hour reaches the sewer, this is providing for a much heavier fall, probably about 1-inch Baldwin Latham after lengthy observation, decided that the average amount of sewage in a town with water supply was about twenty gallons for each person per diem. Half of this will be discharged between 9 a.m. and 5 p.m

As a stream flows on, its velocity will increase and consequently its volume will diminish. So that a pipe running full at its upper end may receive a large quantity more during its course. In upper George street, London, a brick sewer, 5½ feet high, and 3½ feet wide, has a 12-inch pipe laid along the bottom for a distance of 560 feet. This was never known to be at all choked. During storms stones can be heard rolling along the bottom. This pipe is rarely more than half full at the head. The cross sectional area of all the house drains entering it is equal to that of a pipe thirty feet in diameter. Although the 12-inch pipe is always clean, twenty or thirty feet from its mouth in the large brick sewer, deposits of filth are constantly gathering which have to be removed by the expensive method of hand labor. Instances have frequently occurred where workmen have put in as sewers, by mistake, pipes which the architect intended for a single house, and the result has been that they were always clean and served the purpose well.

The round sewer is as a general rule the best. With it we can always secure a good joint by turning the best fitting parts to the bottom. Besides they have the greatest area or amount of wall. The pipes should always be hard and smooth. If at all porous they contaminate the adjacent ground, and render the pipes more subject to frost, and to the destroying action of sewer gases. If there is any danger from roots of trees, etc., it will be advisable to lay the pipe in cement. Where the supply of sewage is very intermittent an egg shaped sewer is sometimes preferred. When the stream becomes very shallow it is also narrow so that sediment is not likely to collect. This latter kind is usually made of brick and are more expensive.

VENTILATION OF SEWERS.

One author describes the danger of unventilated sewers as being greater than that of a steam engine without a safety valve, and indeed it is so, for while in the latter case the lives of but few are exposed, in the former the health and life of the whole community is at stake. As temperature changes, tides rise or fall, the force of wind at the mouth of sewers varies, the pressure of the confined gases is changed. As the amount of water in an ordinary trap is but small the probabilities are that they will be forced or syphoned. If syphoned a direct communication between the public sewer and our houses will be established for the entrance of poisonous gases. Besides, if means be provided for a free passage of air through the sewer the same amount of gas will not be generated, for much of the foul matter in a short time becomes oxidized. Ventilation by means of water pipes to the eaves of houses has been advocated, but this method is faulty, in that when most needed, during heavy rains, the pipes are choked with a flow of water. Most sanitary authorities have decided that the best sewer ventilation yet used are man holes covered with iron gratings, and emerging in the centre of the street. The charcoal ventilator has been used with great success. In the sewerage of Croydon, England, 560 are employed at a total yearly expense of less than $1.25 for each. It consists of a special tray covered with charcoal, set in the ventilator so that all gases ascending are forced to pass either through or over the charcoal. When we remember that one cubic inch of this substance contains as much interior surface as 100 square feet, we can form some idea of its power as a disinfectant. Around the special tray is a box for catching any rainfall or dust which may find its way through the iron grating. These ventilators in order to give thorough satisfaction should be placed every two or three hundred yards in the sewer. They should not break off immediately from the sewer, but should rise from a camber of about a foot, so that passing gases will be more liable to be caught. When the street incline is great, a light hanging valve may be placed above each ventilator. This will not obstruct the flow of sewage, while it will prevent gases rising to the higher parts of the system of sewers, and all escaping from one place or through a few ventilators.

In the city of Windsor, England, in 1856, a case of typhoid fever was discovered. From lack of proper ventilation of sewers the foul and poisonous gases from the faecal matter of this one house, rising through forced and syphoned traps, caused the death of no less than 450 persons, and all of whose houses, without exception, were connected with this sewer

Windsor Castle, having its own drain, escaped the disease In Cassel, also, the breaking out of typhoid fever in the higher parts of the town, while the lower lying portions remained untouched was considered a mystery till it was found that the sewers, not being properly arranged, allowed the poisonous gases to rise to the higher parts of the system where they escaped, spreading the germs of disease. In this, as in many other cases, the community had to be stirred into action by the cruel hand of death.

FLUSHING OF SEWERS.

When a system of sewers is faulty in grade or size, special appliances for flushing should be provided. One good arrangement consists of an iron tank fastened on trunions, having the back end heavier when empty. On being filled with water and waste, the front end becomes the heavier, and it is carted forward. It is faulty in one respect, that when in fallen position all matter issuing from the sewer above it will form a pile of filth beneath the back of the box. Other arrangements such as dams, etc., have been used, but they are insufficient, since they are not self-acting, but require constant attention. Another useful flushing tank for sewers has a disc held in place by the force of the water covering the mouth of the sewer running from the man-hole. The sewage is periodically released by means of a chain fastened to a circular block, but as a precaution a float is attached to the chain so that should the water rise to that height it will liberate itself. If, however, the sewer be properly arranged in other respects they will require but little flushing. During hot summer months, or if fever be prevalent in the town an occasional cleansing will be necessary. The work should always be begun at its lower end, so that there will be no danger of deposits already at the lower end stopping dirt coming down the sewer.

For the purpose of receiving water or arresting silt and solid wash from the streets, catch basins may be placed at the corners of the streets or wherever required. In these the iron for the mouth of the pipe leading to the sewer is hinged at the top, and is cemented to the brick work with plaster paris, so that in case of frost the cement only will break, which can in the spring be easily repaired. Many engineers still prefer the method of conveying street wash away in a separate gully. These conduits may be constructed in the form of deep cast iron gutters covered with a cast iron grating, the inner edge of the gutter being carried up to the height of the sidewalk. As the accumulated flow requires an increase to be made in the depth rather than the width, this would ensure the keeping clean of the gutter. The chief objection to this method is that in the winter time the crossings become coated with ice, but this difficulty seems to be no greater than that arising from ice on the sidewalks and about the catch basins.

THE DRY CONSERVANCE SYSTEM.

The advantages which this system presents are at once evident. The earth given by the Creator to man was intended not as a store-house to be pillaged, but rather to be used. The chief point in its favor is the manurial value of the refuse, which under the waste system is run into the sea, and so far as the present era of the world is concerned—is lost. If year after year, and generation after generation, the nourishing properties be extracted from the soil, the inevitable result must be impoverishment. In a city of 120,000 inhabitants, its yearly supply of provisions of about 100,000,000 pounds is all turned into the sewers, and is lost. This will produce of dried excrement about 5,000 tons. Dr. Voe found that the yearly amount of excrement from an average inhabitant is 56 pounds, and that the amount of organic matter in solid dried excrement was 88%, and in urine 3%. But the total daily amount of organic matter from the latter is about ⅓ more than from the former. Remembering that five-sixths of the ammonia capable of being generated from human excreta is furnished by the urine, and only one fifth by the fæces, and how small is the proportion of the total urine passed at a time, and that it is impossible to collect all the latter, the intrinsic value of the fertilizing matter which can be practically recovered in an earth closet is probably not more than one-third the value, or amounts to 75c. for each person per annum, i.e., taking the usually accepted value of excreta from an average person for one year to be $2.25

By thus discharging its sewage into the lake Toronto loses annually no less than $70,000. Again in supposing the present population of the United States to be 55,000,000, that nation loses in phosphoric acid alone 350,000 tons, which is worth $65,000,000. A small commode placed in a bedroom or dressing-room will be found of no more trouble than a fire place or an ordinary anthracite stove. In cities and towns a regular system for the delivery of dry earth may be established. For houses earth privies of more or less elaborate and complicated forms, all of which, however, work on the same principle, may be introduced.

THE GOUD SYSTEM.

In this system a pail is used, lined with an absorbent such as chaff, old hay, straw, etc. The lining is put in by the aid of a mould, and is designed to absorb the urine and other liquid. The pail is preferably oval, as in this case there is no danger of its collecting filth, in and about the corners. In this case, as in the last, a regular collect and delivery may be established.

(Concluded in next issue).

METAL TRADE OF GREAT BRITAIN WITH CANADA.

The following are the values in sterling of the exports of metals, etc., from Great Britain to Canada for September and for the first nine months of the current year, as given by the British Board of Trade returns:

	September.		Nine months to Sept.	
	1900.	1901.	1900.	1901.
Cutlery	5,288	3,941	46,537	35,585
Hardware	2,032	1,607	20,500	16,560
Pig iron	2,266	5,894	30,871	21,010
Bar, etc	937	1,415	13,024	6,064
Railroad	9,666	52,597	48,748	200,545
Hoops, sheets, etc	6,566	12,412	60,862	45,538
Galvanized sheets	3,183	9,853	74,783	42,975
Tin plates	19,772	17,318	105,671	140,057
Cast, wrought, etc., iron	2,452	8,213	32,940	32,180
Old (for remanufacture)	176	3,364	9,550	20,204
Steel	3,026	14,372	128,570	82,367
Lead	2,901	5,613	18,199	26,041
Tin, unwrought	4,295	4,324	32,463	21,100
Alkali	4,771	....	36,378	....
Cement	5,225	2,361	51,468	28,004
The imports included:				
Pulp wood	25,546	23,631	100,004	250,540

NEW CATALOGUES.

[Note.—Copies of these catalogues will be sent to readers interested, on mentioning The Canadian Engineer.]

Charles Churchill & Co., Ltd., 9-15 Leonard street, London, E.C., American tools, lathes, drills, milling and grinding machines, mechanics' fine tools, etc.

The B. F. Startevant Co., Boston, Mass., electric motors, generators and generating sets, with tables and general information.

Merchant's Red Book, Merchant & Co., Philadelphia, Penn., twentieth century catalogue of roofing and sheet plates, metals, tiles, ventilators, tinner's tools, etc.

F. L. Smidth & Co., Copenhagen and New York, cement plants and general information on cement engineering.

The Wm. Powell Co. Cincinnati, Ohio, brass goods, valves, gauges, etc.

Henry F. Cockill & Sons, Cleckheaton, Yorkshire, England, leather belting.

Tucker's Combustion Apparatus, Baker & Co., platinum refiners, Newark, N.J., description of apparatus for determining the volatile ingredients and total ash of any organic matter.

Joseph Dixon Crucible Co., Jersey City, N.J., graphite preparations for steam, gas and electric automobiles with letters from those who have used them.

Canadian General Electric Co., Toronto, bulletin of single-phase alternating current motors; also belt driven direct current generators.

Dodge Manufacturing Co., Ltd., Toronto, Power Transmission Economics, a list of hangers, clutches, bearings, safety collars, self-oiling bearings, couplings, etc.

It is stated that last year the production of lead in Canada and the United States was some 60,000 tons in excess of the consumption.

Samuel Fisher, manufacturers' agent, Montreal, is dead. Before going into business on his own account he had been for years with Charles Garth & Co.

J. I. Lyle, M.E., who has for five years been connected with the home office of the Buffalo Forge Co., is now manager of the New York branch at 39 and 41 Cortlandt street.

A wealthy sugar manufacturer of Provo, Utah, has decided to erect a beet sugar factory at Raymond, near Lethbridge, N.W.T., to cost $200,000, experiments in beet raising in the locality having proved very successful.

The longest railway run in the world without a stop is in England, from Paddington to Exeter, 194 miles. France comes next, from Paris to Calais, 185½ miles. The longest in the United States is New York to Troy, 148 miles. The longest in Canada is Keewatin to Bird's Hill on the C.P.R., 121 miles.

The contract for the steel superstructure of a highway bridge across the St. John river, N.B., to connect Andover and Perth, has been awarded to the Dominion Bridge Co., of Montreal. The bridge is to consist of five through pin connected truss spans, each 188 feet 10 inches in length from centre to centre.

Fred. C. Ross, the well-known expert rifle shot of New York, has recently associated himself with the J. Stevens Arms & Tool Co., of Chicopee Falls, Mass., to assist Mr. H. M. Pope in the manufacture of rifles and pistols. Mr. Ross is a skilled mechanic, as well as an expert on rifles.

The Cornwall Canal was lighted by electricity for the first time a few days ago. The contract for the electrical machinery was given to an American firm, but owing to their failure to deliver on time, the St. Lawrence Power Co. procured an S.K.C. 2-phase generator of 200 k.w. capacity, at short notice, from the Canadian General Electric Co., and were thus able to fulfil their contract.

James Bogue has been awarded the contract for the foundations of the 500,000 bushel elevator for the Quaker Oats Company at Peterboro. The building will be 65 x 100 and 130 feet high.

A. W. Campbell, Deputy Minister of Public Works, and well known in connection with the good roads movement in Ontario, says the progress in the latter respect is simply marvelous. Modern machinery is being everywhere introduced and improved roads are the order of the day.

In connection with the visit of Lord Strathcona to Canada, it is reported that negotiations have been resumed for the early establishment of a fast Atlantic mail and passenger service, which the Government, in view of the good harvest and general prosperity, is anxious to have established with the least possible delay. Lord Strathcona thinks that the time has arrived when the people of Great Britain should know, by such proof as this line would afford, how much nearer England is to Canada than to the United States, and if accompanied by an improved passenger line between Canada and Australia, would divert a great amount of the passenger business between Australia and Europe through Canada.

A new survey is to be made of the Great Lakes and new charts issued to meet the requirements of deep draught vessels. A new chart of the Detroit river is also being prepared, showing the channel from Detroit to Lake Erie, containing valuable information and details on a large scale of Bellard's Reef and the Lime Kilns Crossing. Under the direction of Major Fisk the flow of the Detroit river is being gauged. Similar work is progressing at the Soo. That in the St. Clair river, the St. Lawrence river and the Niagara river has been finished. This work is part of the great undertaking by the Government to gather data regarding the lake water levels, and measurements at the various points named will be used in finding out the supply from the various sources and tracing down the sources. Referring to the idea that Lake Erie levels are falling, and that before long something will have to be done to maintain the level, Major Fisk declares that conditions are not alarming, but if the worst should come, it would not be a very difficult task to build a dam across Niagara river, and thus raise the Lake Erie level several feet if necessary. He says that there is no danger the power plants at Niagara will consume enough water to materially affect the lake-level.

ENGINEERS, Electricians, Machinists: Secure subs. for the "Power and Lighting Economist", Troy, N.Y. Use idle hours to double your wages.

MICA COVERING

For Boilers, Furnaces, Steam and Hot and Cold Water Pipes, etc.

Fire and Frost Proof.

WINTER SEASON 1901-1902.—This is the time to protect all exposed steam pipes and heated or exposed surfaces. To ensure reasonable delivery order your covering **now** The demand for Mica Covering is rapidly increasing and our recent extensions in Montreal are already overtaxed. Mica is being used throughout Canada because it has been proved to give the best results It carried off the Gold Medal at the Pan-American, and was a prize winner at Paris. Write us for list of large users, testimonials, prices, etc., and form your own judgment

Mica Covering Boiler Company, Limited

86 to 92 Ann Street, Montreal.
98 to 100 King Street W., Toronto.

RUBBER BELTING

"We cannot afford to furnish any belting other than we consider to be the best, hence we buy yours."

JOHN ABELL,
Toronto, Ont.

THE CANADIAN RUBBER Co

MONTREAL TORONTO WINNIPEG

The Canadian Engineer

VOL. VIII.—No. 20. TORONTO AND MONTREAL, DECEMBER, 1901. {PRICE 10 CENTS / $1.00 PER YEAR

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

Toronto Telephone, Main **1392. Montreal Telephone,** Main **2589.**

BIGGAR, SAMUEL & CO., Publishers,

E. B. BIGGAR. R. R. SAMUEL

TRAVELING REPRESENTATIVE: A. W. SMITH.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month, or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

	PAGE
Bi-Polar Sturtevant Motor	474
Canadian Manufacturers' Association	466
Canadian Society of Civil Engineers	483
Canadian Wood for Paving	465
Duryea Automobiles	472
Electric Flashes	479
Engineers' Club of Toronto	484
First Long Distance Transmission Plant in Canada	461
German High Speed Electric Railway	469
Great Dam on the Nile	474
Hydro-Electric Plant at Swan Falls, Idaho	475
Illumination of Adelaide	466
Improved Russell Staple Puller	460
Industrial Notes	476
Literary Notes	483
Marine News	482
Mining Drill	471
Munro, Robert	474
Multiple Telegraphy	475
Mining Matters	482
Metal Sawing Machine	483
Miscellaneous Notes	486
New Catalogues	XXII.
New Incorporations	XXIII.
New Mine Tachymeter	468
Personal	482
Powerful Dredge	485
Railway Matters	481
Sanitary Drainage of Houses and Towns	467
Submarine Signalling	463
Stationary Engineers	485
Telephone Problem in Canada	464
Telephone Systems in Private Houses	484
Theory of the Steam Engine	472
Vertical Spindle Milling Machine	471
Wire Nails, Something about	474

The articles now running in the Canadian Engineer on the Electrical Power Developments of Canada, will be reprinted in book form, with diagrams and folding plates. Price $5.00 per copy. Advance orders received.

The index to the current volume will be ready in a few days, and will be mailed to subscribers on application.

THE FIRST LONG DISTANCE TRANSMISSION PLANT IN CANADA.

The North Shore Power Co.'s water-power development on the Batiscan river, Quebec, possesses a peculiar interest from the fact that it was the first long distance transmission in Canada. The company was formed for the purpose of supplying light and power to Three Rivers, Que., a city of 12,000 inhabitants, situated at the confluence of the St. Maurice and St. Lawrence rivers, almost half way between the cities of Montreal and Quebec, the distance to either of these points being about ninety miles.

Location of Development.

Their development is located on the Batiscan river, at what is known as the "Grand Chute," distant about 16½ miles from Three Rivers. The Batiscan is one of the tributaries of the St. Lawrence river, flowing from the northern watershed formed by the Laurentian Hills, and it has a drainage area of 2,000 square miles of thickly wooded territory above the point of development. At these falls the river drops 50 feet in an abrupt cascade, and under this head the available power at low water would be about 2,500 h.p. At a very short distance below the present development, the company is said to own another power with about the same head, which would enable them to develop another 2,000 h.p., bringing up their total available power to 4,500 h.p. Of this, a large amount would be lost in the winter through the action of frazil. The present development was commenced in September 1st, 1896, and completed ready for operation on May 1st, 1897.

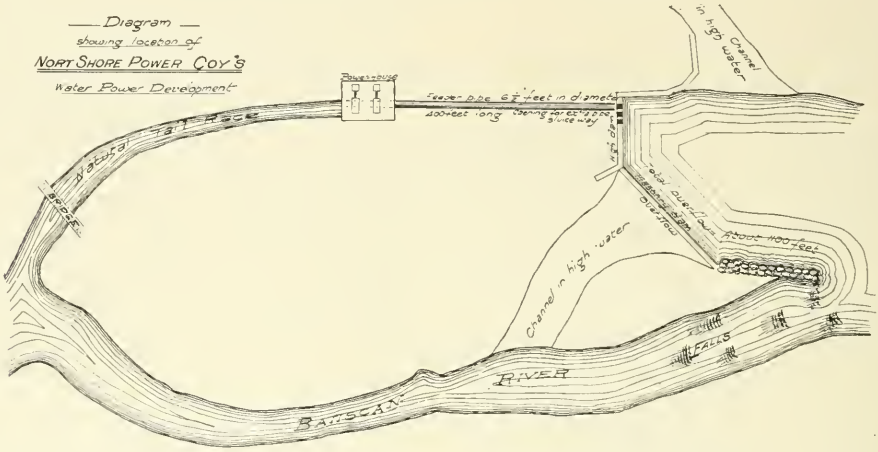
Hydraulic Development.

The conformation of the ground made the task of development quite simple. The power-house stands between two channels of the river, one of which, however, is dry except at seasons of high water. The width of the river between these channels affords an overflow nearly 1,100 feet long, so that at high water the river does not rise to a dangerous height. In addition to the long overflow provided, a part of the dry channel has been left open so as to form a water-way at high water. The dam does not extend right across the river, the main channel at the head of the falls being left open. Part of it is of the double batter type, founded on the solid rock throughout and built of rubble masonry laid up in cement mortar, the stone being taken from the site. The balance of it is carried out at a lower level and is built of loose stone. The dam is at present overflowed at high water only, the normal flow of the river passing through the open channel and over the low part of the dam built of loose stone. Whenever the company decides to develop the balance of the power, a dam will doubtless be thrown across the main channel and the loose rock dam replaced by a water-tight structure. Owing to the very limited demand for power at the inception of this enterprise, the company was obliged to keep the initial expenditure down to the lowest possible point. They succeeded in doing this in a very creditable way, and although the work on masonry, etc., is rather rough, it is, nevertheless, quite substantial and answers the purpose very well. The amount expended on masonry for dam is said to have been only $1,000. The formation of the ground favored cheap construction. The work was carried on at low water and little or nothing in the shape of coffer-damming was required. All work was done by day labor under the supervision of the company's manager, Mr. Fregeau. The bulkhead provides for two penstocks of 6½ feet diameter each, of which only one is at present carried down to the power house, The entrance to feeder pipes is controlled by stop-logs sliding in a rough check in the masonry. The penstock is 6½ feet in diameter and about 400 feet long. It is built of ⅜ inch and ⅝ inch boiler plate supported in masonry saddles 15 feet apart. Two 6 inch spring relief valves are set on the lower end of the penstock to control water hammer, etc. A 12 inch gate valve is set on the lower end of the penstock to drain it out when required. The penstock is covered over with spruce boughs. In the summer these shade the penstock from the sun, and in the winter time they become covered with a thick matting of snow, forming a protection against the cold. This forms a very cheap protection, the only objection to it being that it does not admit of a regular inspec-

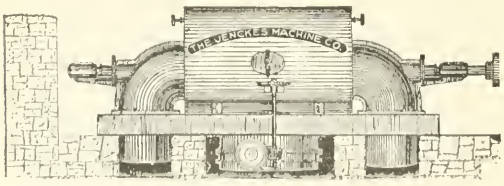
tion of the penstock for painting, etc., and that it interferes with free ventilation around the penstock, thus tending to destroy the paint and assisting the action of the rust. It is expected that a wooden frame structure will be built this fall to protect the penstock.

POWER HOUSE.

The power house building is quite a substantial stone structure with galvanized iron roof. It is well lighted by large windows in daytime and incandescent lights at night. The flooring is of pine and the building is heated by wood stoves. The risers from the penstocks to the wheel cases are controlled by butterfly valves. There are at present



two turbine units with direct connected generators installed. The turbine units consist of double 21-inch register gate Crocker turbines mounted on a horizontal shaft and having end discharge, which were supplied by the Jenckes Machine Company, of Sherbrooke, Que. The feeder from penstock delivers into the centre of wheel case from underneath, the wheel case straddles the penstock at right angles, a draft tube for each turbine with a quarter turn being set on the ends of the case The speed of the turbines is 400 revolutions per minute under the normal head. The masonry foundations and settings are well designed and the turbines run very steadily. As the load on the turbine is confined to lighting only, and is, therefore, fairly even, no



One of the Water Wheels in Case.

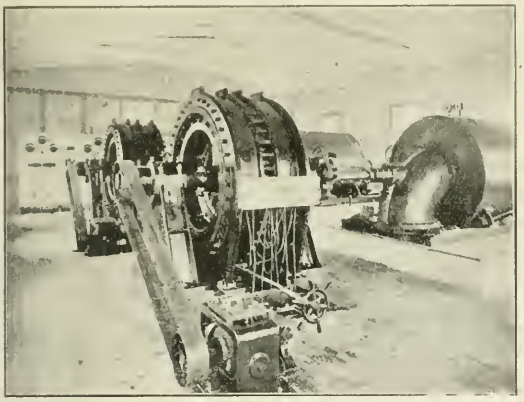
governors are used and the gates are regulated by hand wheel only. This appears to give close enough regulation. The couplings between the turbine shafts and the generators are of the leather link type. These couplings are similar to the ordinary flange coupling, except that the adjacent faces have projecting pins inserted in their faces on circles of unequal diameter connected for driving by means of heavy leather links, making a flexible coupling which permits the generator to run satisfactorily even when the shafts are not in absolute alignment.

The two generators are of the S.K.C. type, two-phase. They are rated at 240 K. W., 16,000 alternations and generate at 2,000 volts. They are well set up and run quite easily and smoothly. They have each a belt connected exciter rated 10 K.W., 500 rev., 80 Ampere at 50 volts being required for excitation at full load. The generators are designed to work in parallel and the wires are carried to and from switchboard in shallow trenches in the floor covered with loose hatches. The regulating switchboard is of white marble and is of a neat design with ordinary knife switches. For purpose of transmission the current is raised to 12,000 volts by step-up transformers placed in a separate room divided from the main power by a glass partition only. These transformers are in 60 K.W. units, there being four for each phase of the plant. They are of the self cooling type, a natural draft being formed by galvanized stacks projecting some distance above the roof. The switches on the 12,000 volt side are of the S.K.C. non-arcing plug type. These switches will break a 12,000 volt arc without danger to the operator, Two static ground detectors are placed on the transformer board. These are directly connected to the high tension wires, and are for detecting any grounds on the transmission line. From the transformer board the wires are led to a wooden cupola and from this starts the

TRANSMISSION LINE.

The transmission line, the first long-distance, high potential line built in Canada, consists of four No. 1 copper wires, strung on double petticoat porcelain insulators. The poles are of cedar 35 feet long, set 5 feet into the ground and placed 100 feet apart. Three barbed wire lightning arrestor wires are carried along over the power wires and grounded every fourth pole. This protection against lightning is supplemented by banks of lightning arrestors at each end of the line. The line is first carried through the bush to the public road, then along the road alongside the railway and from thence crosses the St. Maurice River on the highway bridge. The whole line is well set up and has given very little trouble since it was first erected. The sub-station in the City of Three Rivers is located in the town pumping station. The city formerly operated a lighting plant here driven by steam, and the North Shore Power Co. took over this plant and is now operating it with power from their development. This current is reduced by step-down transformers, down to 1,100 volts, which was the voltage used on the old system. In fact everything, including the frequency of alternations in the generators at the power station, was designed to fit in with the old system, so that very little change was required in sub-station arrangements or distributing system.

The company has now in operation 6,000 16-c.p. incandescent lamps, 100 32-c.p. lamps and 87 1,200-c.p. arc lamps from T.H. arc dynamos driven by a synchronous motor, formerly one of the A.C. generators in the old plant. The demand for light has increased very rapidly within the last two years and the prospects for the future are quite bright.



Interior of Generating Plant.

The opening of the St. Maurice river valley, of which Three Rivers is the metropolis, caused by the important manufacturing developments at Grand Mere and Shawinigan Falls, has given this city quite a boom. The principal industry at present is the sawmill and lumber trade, and this does not afford a market for power, as they have more fuel in the shape of wood refuse than they can use, but small manufactures of various kinds are commencing to spring up, and the market for power in that direction will probably improve. Two or three electric railway schemes are in the air, one of which would use 600 to 800 HP. The North Shore Power Company have a 20-year charter for the exclusive sale of light and power in Three Rivers

The Water Fall.

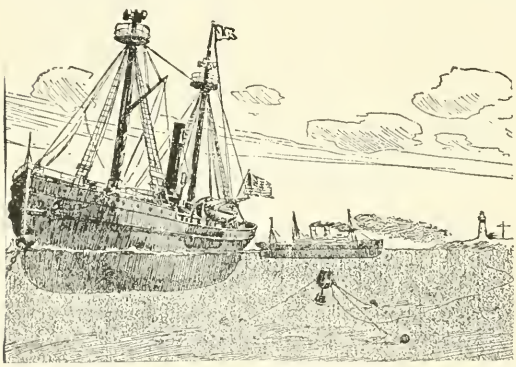
which has 15 years yet to run. The directors of the company are as follows: President, Hon. C. C. Colby; Vice-President, P. E Panneton; Secretary, S. Stevens; Managers, J. B. Fregeau and H. E. Channell.

As before stated all masonry and other building work was done by day labor. The contractors for the penstock, turbines and other hydraulic plant were the Jenckes Machine Co., of Sherbrooke. The Royal Electric Co., of Montreal, were the contractors for the entire electrical equipment, Wm. Kennedy. C.E, of Montreal, was consulting engineer for the hydraulic installation.

SUBMARINE SIGNALLING.

The system of submarine signalling for the guidance of shipping, soon to go into practical operation at the entrance of Boston harbor, is to be adapted to the conditions of the St. Lawrence river as early as practicable. Sir William Van Horne, who is deeply interested in the invention, is confident that by this means the navigation of the St. Lawrence and its approaches from the sea can be made perfectly safe, and that thus the disadvantages under which the ports of Montreal and Quebec now labor will be overcome. The system is the joint invention of the late Prof. Elisha Gray and Arthur J. Mundy, of Boston. It is based upon the principle that water, being a stable medium, transmits sound under conditions that practically are unvarying. Therefore, it is certain that a signal given under water will always be heard at the place and time intended, and not be subjected to the great uncertainties caused by atmospheric fluctuations, with currents and areas differing extremely in temperature and density and correspondingly in conductivity, so that air signals sounded close at hand are frequently not heard. When installed at Boston, the system will comprise two submerged bells, one on either side of the harbor entrance. These bells are struck simultaneously through electric cable connections from the shore. The bells sound different numbers and therefore can easily be identified. They are so located that a line drawn upon the chart along a course leading directly to the beginning of the harbor channel also traces the course where the two bells will be heard simultaneously. Therefore, if the navigator of a vessel hears either bell first, it is evident that the vessel is nearer that bell and correspondingly off the proper course. And since sound travels under water at the rate of 4,712 feet a second, the interval between the sounding of two bells will show the distance from the course in one direction or the other at any given moment. These constant promptings, therefore, enable a vessel to feel her way unerringly to points where the chart gives the exact course by compass to the harbor entrance. By this means a vessel can find the way into or out of port in any weather with absolute certainty. The system would be adapted to the conditions of river navigation, as on the St. Lawrence, by placing a series of such bells at stated intervals, say at every turn of the channel. A vessel could thus lay its course from one bell to another, and by noting the sound-intervals, the distance from these points at any moment would be known. Although the idea is so simple, its practical application has required a long series of delicate and costly experimentation, which has led to the development of various ingenious methods for transmitting, recording and receiving sound. For instance, by the use of certain ingenious devices, invented by Prof. Gray, it has been found possible to perceive submarine signals at enormously greater distances than had been supposed practicable, and the limit at which sound-waves may thus be detected has by no means been reached. Another notable device invented

by Prof. Gray is a receiver, that tells just the direction from which a signal proceeds. Yet another device by the same inventor makes it unnecessary to listen at a receiver for the sounding of a bell, for whenever such a signal is sounded, a gong in the pilot-house is rung automatically by sympathetic vibration. Mr. Mundy is to be credited with the invention of certain valuable mechanical devices in connection with the system, one being a little instrument that records the length of sound intervals in the striking of signals. Mr. Mundy is also the author of a method of "accoustic triangulation," in connection with this system, by means of which—three bells being arranged in an equilateral triangle and sounded successively at regular intervals, say of ten seconds—the position of a vessel may be determined exactly by noting the time between the signals. The system, in connection with a signal code, offers a means for communicating with lightships to and from the land, also from ship to ship at sea and between ships and the shore. The receiver of the system also enables a warship to determine the approach of an enemy, say a submarine torpedo-boat, by detecting the vibration of its machinery.



Sub-marine Signalling to and from a Light-Ship.

This system was first suggested to Mr. Mundy by the recollection of the child's experiment of striking two stones under water and hearing the sound while the ears were submerged. It is rather strange that the only recorded tests of sounds under water appear to have been made at Lake Geneva about 50 years ago, and but little attention paid to the matter since. It was then found that sound travelled under water at 4,708 ft. per second, but Mr. Mundy and Prof. Gray determines it at 4,712 ft. against the average of 1,120 ft. per second when transmitted through air. As before indicated, a signal through air, whether by whistle, fog horn or gun, may be heard 15 to 40 miles away under one condition of atmosphere, and less than 100 yards away under another; depending on the density, temperature and motions of the surrounding belts or areas of air. These freaks and tricks of air have been brought out frequently in enquiries concerning the loss of vessels or accidents at sea or on railways. When these drawbacks of air signalling and the variability of ocean currents in the Gulf of St. Lawrence are considered, the importance of this new system to the marine interests of Canada will be appreciated. As the experiments at Boston show that sounds of a submerged bell are audible up to a distance of 12 miles, with a probability of this range being increased, it would appear that the new system should, on the whole, be cheaper than the present unreliable air signalling system, and we would recommend the Dominion Government to make a test of it experimentally in the channel of the St Lawrence between Quebec and Montreal.

THE TELEPHONE PROBLEM IN CANADA.

ARTICLE II.

In last issue we gave some facts and figures regarding the remarkable progress of the "Independent" telephone movement in the western and central states of the American Union in opposition to the Bell, and we direct attention to the moral which this movement conveys to Canadian cities and towns which are suffering the frequently poor service and generally excessive rates of the Canadian Bell Telephone Co. By poor service we do not necessarily mean that the operatives are less efficient or attentive than the average, but that the Bell equipment is, as a rule, of an antiquated type. For years past the Bell company, secure in its monopoly, has paid but little heed to public convenience, except when changes suited its own convenience or made for economy in its own working expenses. It is true that it has made improvement in the large cities when a knowledge of what has been going on in United States cities having the benefits of the independent lines has made it policy to concede something to the general protests, but even here the subscribers have been made to pay individually and collectively for improvements, the cost of which was more than covered by the company's annual rates. That is to say, in Canada, the Bell subscribers pay a high rate for an antiquated equipment and service, and when they desire improvement they pay extra to get what all independent companies in the States are quite ready to supply, not only in better quality, but at considerably lower rates, and still make a reasonable profit to shareholders. If Smith's grocer after allowing his delivery wagon to become dilapidated, came and said: "Mr. Smith, I propose to improve my facilities for rapid delivery of your purchases by getting an up-to-date new wagon, but as this improvement will be very expensive I must increase the price of your sugar a cent a pound for the next year to assist in repaying part of the interest on this heavy outlay." What would Mr. Smith do? He would promply transfer his custom to another grocer who would be willing to provide a decent delivery wagon and supply Smith with sugar at the market rate. This grocery proposition for making the customer pay for the proper delivery of goods is what the Bell company is doing in Canada, with this difference in the situation, that when the customer objects to paying the extra $5 a year to get his goods delivered in proper shape he has no other telephone company to go to. In United States cities of late they are not content to let one grocery do the whole trade of the town, hence the steady growth of the independent telephone companies. We could fill several pages with notes of new local companies started within the past month in opposition to the Bell, and several States have State associations formed to advance the common interest of these independent companies, Missouri being the latest to organize such an association. It is surprising to learn from reports presented at the recent convention of the Kentucky Telephone Association that the Independents in those States where the movement has got fair headway, are ahead of the Bell, having more exchanges, toll lines and phones, and giving a better service. The movement appears to have got the firmest footing in the western States, and has spread from there to the southern and eastern States. Since the expiry of the Bell patents six

years ago over 3,500 exchanges, using over 1,000,000 'phones, have been established by the Independents in the United States. In the twenty years that the Bell controlled the territory now covered by the Independents that monopoly was only able, according to the Telephone Magazine, to create a demand for 582,506 instruments, or barely more than half of what the Independents have accomplished within six years. And yet, while giving a better service and better instruments, the Independents are able to declare good dividends, some of them as much as eight per cent., and it is a remarkable fact that except for the fraudulent sale of the Detroit company to the Bell not one of the larger independent companies have failed or gone out of business. These facts and the further fact that the gross earnings of the American Bell Company from 1892 to 1899 were $40,576,344, while its operating expenses were $10,881,468, have a moral for Canadian telephone users and investors.

The true solution for the Canadian people is the Government ownership of the telephone business, but judging by the fact that our Secretary of State stood up in Parliament as an advocate of the Bell company's application for increased capital without Government interference with its rates there seems little to hope for from our Government unless it is scared by a public agitation. The alternative therefore is to follow the plan of United States cities, and starting from a well chosen centre work an independent system radially district by district. Starting from a city like Toronto the main advantages of a long-distance system, combined with cheap local exchanges, can be secured up to a distance of 50 to 75 miles. That is to say, cities, towns and villages as far as Guelph, Berlin and Brantford on the west, Hamilton and the Niagara peninsular towns on the south, Port Hope and Peterboro' on the east and Orillia on the north may have the benefits of a much better service and at much cheaper rates than they are getting now, and at the same time make an investment yielding dividends that will be kept in their own town instead of going abroad. We mention this geographical area as the majority of the long-distance messages going to and from Toronto are within these distances, so that for practical purposes such an independent company, or aggregation of local companies, would provide a long-distance service. Where individual users wished to go beyond these points they would have the Bell service by paying for it as they do now. One advantage such a company can give is that a chain of what is called farmers' telephone lines can be profitably attached to this system, greatly to the benefit of the trade of the surrounding towns and villages. These farmers' lines have proved a very successful adjunct to the business of the Independent companies in the Western States, and is in a sense their creation, as the Bell ignored it, or refused to supply the want at a reasonable rate. In the thickly-settled rural districts of Ontario from the Detroit river to the Ottawa, there is a good field for enterprise here, apart from the independent telephone movement, and we hope to give more information on farmers' lines in another number.

The spasmodic efforts heretofore made in Montreal to establish an independent exchange, should not be repeated in Toronto. The enterprise should not be conceived in a spirit of enmity to the Bell company, but wholly as a business venture which will yield a good return to shareholders, supply a better service than the Bell is giving, and at the same time extend the use of the telephone by making it cheaper. That the indirect as well as the direct return for such an investment can be assured we hope to be able to show in another issue.

CANADIAN WOOD FOR PAVING.

There seems likely to be a demand in the near future for Canadian wood for paving in England. The city engineers of Westminster and Liverpool, as a result of recent experiments, have pronounced in favor of Canadian tamarac and white spruce, and a number of authorities in other cities endorse their opinion. Canadian red pine is also recommended, and is pronounced to be equal to and cheaper than Baltic redwood. Some Canadian blocks laid in Trafalgar Square in 1896 have been found quite sound after five years and worn away only $\frac{3}{8}$ of an inch on the average. Mr. Rust, city engineer for Toronto, says cedar has been found the best adapted of Canadian woods for street paving, but the tamarac and spruce of the maritime provinces are harder than what is found in the west, and the supply for export to Britain would naturally come from there. The wood is treated with creosote before being laid.

—Presence of mind on the part of a clergyman, and a cup of water, averted what promised to be a serious, if not a fatal accident on the Sydney and Louisburg Railway recently. A lamp in the passenger car took fire and the flames bid fair to extend to the roof of the car. The conductor tried to remove the lamp without success, when the clergyman, who was a passenger, ran to the next car and brought a cup of water, with which, by a well-directed shot, he put out the fire. Some of our readers may recollect an accident on the Grand Trunk near Komoka, from a similar cause, many years ago, by which a number of passengers lost their lives, or were seriously injured by jumping from the train.

—An influential deputation from Montreal waited upon the Dominion Government recently to urge the adoption of means for the improvement of the navigation of the St. Lawrence. Their prime object was to secure lower rates of insurance, but the means by which they proposed to effect their purpose are interesting from an engineering point of view. They want a thorough examination made of the St. Lawrence route from Montreal to Cape Race and Belleisle, by an experienced British hydrographic engineer, who would have Canadian engineers associated with him in the work. The Canadian Government would be expected to undertake any works that might be recommended for the improvement of the route. Two improvements are urged, the deepening of the channels to 30 feet, with a width of 400 feet, and a system of buoys with lights, so that the channel could be navigated by night as well as by day. The deputation also urged the extension of the Government railway west to a point on the Georgian Bay, so as to come into touch with the great lakes carrying trade and securing grain freights from Canadian seaports which now go to New York. The extension would probably take the form of an air line from Riviere du Loup to some point on the Georgian Bay, crossing at the new Quebec bridge. The deputation was cordially received and their representations will doubtless be favorably considered.

Prof. R. A. Smart has resigned his position in the Department of Experimental Engineering of Purdue University at LaFayette, Ind., and connected himself with B. F. Sturtevant Co., of Boston, Mass., with whom he will become the head of a department of experimental engineering which is being established for the purpose of investigating all problems relating to blower practice, and of developing new and more efficient applications of the fan blower in all lines of industry.

CANADIAN MANUFACTURERS' ASSOCIATION.

The annual meeting of the Canadian Manufacturers' Association was held at Montreal on the 5th and 6th of November. Interest centered largely around tariff changes, and the woolen men, who are specially affected by the preferential tariff, were to the front. The membership of the association has increased largely, 825 being reported in good standing, with 28 applications. The number reported last year was 342. The association has endorsed the metric system of weights and measures.

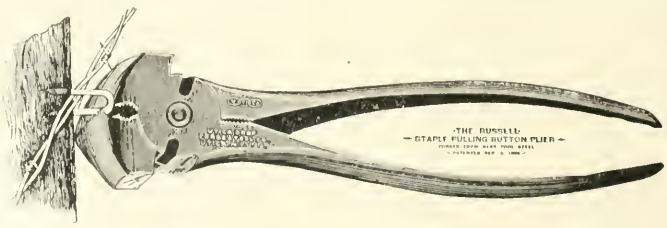
The result of the deliberations of the association was embodied in a series of resolutions: (1) Advocating reciprocal preferential trade with Australia, and between Canada and every part of the British Empire. (2) Affirming the desirability of improved ocean freight carriers. (3) Asking that the association be consulted on any proposed legislation to amend the patent, trade mark, design and copyright laws. (4) Relating to trade and navigation, bankruptcy and other minor matters. (5) Asking tariff changes on woolens, folding boxes, shirts, collars, cuffs and blouses, lumber, shingles and lath, oatmeal, agricultural implements, bleaching powder, granite (finished), iron and steel, reed and rattan furniture, baby carriages and a few other minor articles. (6) In favor of a better method of preventing undervaluation and the importation of imperfect goods and surplus foreign manufactures at less than standard values.

The address of the retiring President, P. W. Ellis, of Toronto, was able and elicited many complimentary notices. It will be printed in pamphlet form. Robert Munro, of Montreal, was elected president.

The next place of meeting will be fixed by the executive. It will be some point east of Montreal. A banquet was held at which Sir Wilfrid Laurier and Hon. Messrs. Fielding, Paterson and Tarte spoke. A conference was held with them on tariff matters. The meeting was the most successful the association has ever held.

IMPROVED RUSSELL STAPLE PULLER.

The Utica Drop Forge & Tool Co. and the Smith & Hemenway Co., of 296 Broadway, New York, have brought out an improved form of the Staple Puller as shown herewith. The new features include a device between the jaws and the rivet for tying barbed wire, and a wire splicer on the opposite side of the rivet for splicing plain wire. The head of the tool is now shaped so that depressions and uneven places in posts, trees, etc., can be readily reached to withdraw a staple or nail. There are two staple drawing grips; one on each side of the head. Other changes are in the form or shape of the jaw ends, which now have a flat and larger hammer surface on both sides of the jaw. This tool is a combination of two staple-pincers, monkey wrench, two nail pullers, and two wire cutters. It can be used to cut wire on both sides



of the plier, splice, straighten or tighten wire. It is designed more particularly for putting up, removing and repairing wire, etc., farm and railroad fence. It is 10½ inches long and weighs 1¼ lbs. The Smith & Hemenway Co. issue the Green Book of Hardware Specialties, and it would be well for anyone desiring further information in regard to the goods of this company to write for a copy of same.

ILLUMINATION OF ADELAIDE.

In last issue we gave some samples of electrical illuminations in honor of the Duke of York's visit to Canada. Our

readers will be interested in the accompanying views made from photographs by Noyes Brothers, of No. 31 O'Connell street, Sydney, Australia, showing electrical illuminations in the city of Adelaide, South Australia, on the occasion of the Duke's visit to the new Australian Commonwealth. This

work was carried out by the Westinghouse Electric and Mnfg. Co., under contract with the Government of South Australia. There are in all 11,000 lamps run from two stations, requiring a total generating capacity of 200 kilowatts. The entire work was carried out in thirty days, machinery being shipped from Sydney. The work was entirely satisfactory, and ran without a hitch, eliciting the formal thanks of the Government of South Australia for the manner in which the contract was carried through. The whole of the machinery comprising the generating plant consisted of Westinghouse apparatus. One of the views shows the postoffice, town hall and treasury building at Adelaide, while the other represents the ducal arms upon the parliament house.

THE SANITARY DRAINAGE OF HOUSES AND TOWNS

By H. G. Tyrrell, C.E., Boston, Mass.

(Concluded from last issue).

ASH CLOSET.

Although some better systems such as the water or dry conservance should be used, if possible, yet in many small villages and towns in the country, public sentiment has not yet reached the state in which to accept of these more complicated and apparently more expensive methods of disposing of the waste from human habitations, and are content with some more simple system, such as an ash closet or ordinary privy. The exact length of time that excrement may lie, before becoming dangerous to health, is by sanitary authorities not yet settled upon. However, we may fairly conclude that if a daily removal be arranged no danger need be feared. The whole advantage of the ash closet lies in having the liquid waste soaked up by the dry ashes from our stoves. The otherwise noxious putrifaction will become a healthy decomposition. Although this precaution be taken to prevent the generation of poisonous gases, we must not conclude that this is sufficient protection. The refuse must be regularly and frequently removed, the time between collecting in no case exceeding a week. In the cities of Hull and Manchester in England, this system is used with great success. The privy used is the one where the whole receptacle for excrement and ashes is under the seat. The bottom of this space is built of brick and flag stones, so as to be smooth and hard. The front board is movable so that on withdrawing it the scavenger can remove all filth with ease. The ashes may of course be thrown in whenever convenient, the principal requirement being that a supply should be added each day. In some of the lower portions of the city of Hull and especially among the poorer classes, the inspector of nuisances found many of the vaults overflowing and reeking in filth and disease. But this cannot be laid as a charge against the dry ash system, for among the poor and dirty of a city any contrivance is likely to be neglected by them, and the best method for such classes seems to be that which is constantly attended to by the city authorities.

Another way more suitable for a country residence is to have a large removable pail beneath the seat into which excrement and ashes are thrown. It would be more convenient in this case to have a small door in the back of the wall from which to remove the pail. Half of a petroleum barrel is the pail most commonly used, but one with a spherical bottom would be much better, as dirt would be more easily removed. For a closet two or three such vessels must be provided, so that while one is in use another after being emptied and cleansed may be airing in the garden or field.

PNEUMATIC SYSTEM.

We see in turn all the elements being called upon as aids in the drainage of town and village, for while before we had earth and water employed, we now, in our new system, seek the aid of the air we breathe, in the removal of refuse from our habitations. This system, which is as yet but little used on account of its recent discovery, has whenever tried, chiefly in Holland and Austria, given very satisfactory results. It is to the research and ingenuity of a Dutch engineer, Charles Tiernur, that the scientific world is indebted for the discovery of a system which is undoubtedly the greatest modern invention in sanitary science. It consists in having a number of air tight iron reservoirs, as many as the size of the town demands, sunk to a sufficient depth beneath the surface to prevent freezing, to which are connected the house drains of the town. This iron chamber is at certain intervals exhausted of its air, so that when valves are opened connecting with the drains of the town the pressure of the atmosphere forces everything from the pipes down into the central reservoir. If the number of these is large they may all in the same way be emptied by a similar process into one central final vault. The chief difficulty that presents itself in this undertaking is that some pipes would eventually be emptied before others, in which case the air finding easy access through the empty drains, could no longer affect those still full. But the obstacle was early overcome by referring to the principle of equal barometric resistance. Before entering the main each house drain is provided with a break or abrupt change in elevation, of say exactly one foot. Now suppose that while one drain discharges a large quantity daily another supplies but a small quantity of sewage. Then if the air be extracted from the main, so that atmospheric pressure acts in both house drains, the liquid in the first will first descend before that in the second begins to move. Then when they have both reached the same point the liquid in both will flow out together. In the same way no matter how great the number of drains, they will all be emptied at the same instant. The closets, as originally made, were simply the iron hopper closet, being placed if possible one above another, so that the fall may be nearly straight. But any other may be used equally well, provided a large sized ventilation pipe passes up through the roof by which the atmosphere may exert its full pressure on the liquids in the drain. As the sewage at the final depot is run through sieves and evaporated for use as a fertilizer, the street wash and kitchen slops are usually conveyed by a separate set of pipes into a lake or stream. The chief advantage this method has above the others is that it returns to the soil that which we have taken from it, and also the income from the sale of the product soon pays for the construction of the work, and is less expensive and more economical.

THE FINAL DISPOSAL OF SEWAGE.

This is perhaps of all problems in sanitary science the most difficult. Attempts have been made for the disposal of sewage, such as irrigation, ignition, etc., but no complete and satisfactory method has yet been devised. For small villages and single residences in the country the problem is simple enough, but in towns and cities when the quantity of solid and liquid refuse is great, it is much more complicated and obscure. We cannot discharge our sewage into a lake a few rods, it may be, from our waterworks, and the mouth of our water main, neither can we be so inhuman as to run our sewers into a stream from which a few miles farther down another town derives its supply of fresh water.

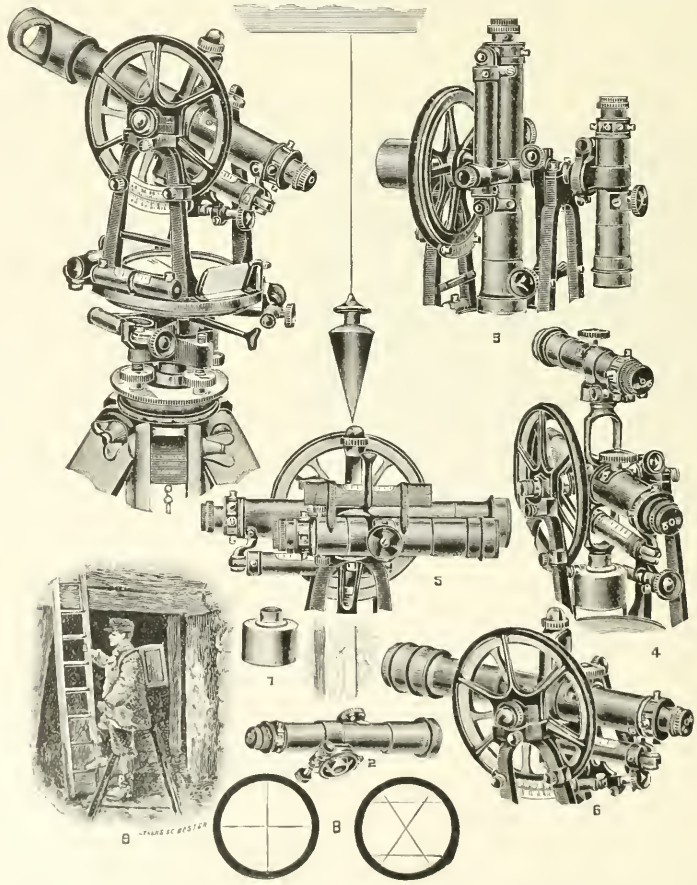
Perhaps the most successful solution yet presented for the subject is that of irrigation. Experiments go to show that for this purpose we should have at least one acre of land for every 150 of population. The soil most suitable for this purpose is a loose gravelly one, thoroughly drained at a depth of about six feet below the surface. The same plot should not be used continuously, for sufficient time should be given at intervals for the ground to be thoroughly aerated. On being thus exposed to earth and air all organic particles become so oxidized that the liquid passes off in a comparatively pure state, and may with safety be discharged into a lake or stream. This system requires but little time to pay for itself, for the amount of extra vegetation produced yearly on the irrigated soil has in almost every case been equal in value to a large proportion of the original cost of land and labor. At Coventry, in England, the liquid sewage is rendered harmless by mixing with it sulphite of alumina. The engineer in charge of the works there states in his report that the fluid passing off at the rate of 80,000 gallons per hour was clear and bright, and not only so, but of a high standard of purity It was without smell or color, and at noon was found by the celebrated analyst, Dr. Voeleks, to contain but 5.85 parts of ammonia in 100,000 parts The solid matter from the sewer after being separated from the liquid is dried and sold as a fertilizer for the land. In order that the discharge may be more copious, various storage tanks have been devised, so that when a flow occurs it will be dispersed over a greater extent of land. The one recommended by Mr. Warren is that invented by Messrs. Denton and Field When circumstances will allow, house slops may be discharged beneath the lawn or garden as described in the fore part of this paper. In the town of Salford, England, the precipitated sewage first runs into shallow pits where it is partially dried, after which it is burned in large kilns. This method, although deriving no income from the waste of the town, and on the other hand creating a little expense, has the advantage of immediately and thoroughly destroying the source of disease which is far better than storing up evaporated excretion with the expecta-

tion of selling, and at the same time spreading sickness through the country.

And now seeing, as we do, that the great mass of deaths which occur from zymotic diseases, are due to causes which we might have prevented, should we not as individuals and as communities, make the proper and healthful drainage of our houses the first and foremost important consideration in their construction. Let, therefore, no man be so great a blasphemer as to say on seeing a friend taken away, a victim of typhoid fever or diphtheria, that it was an act of an All-Wise Providence, but let him rather feel that he himself is largely responsible for his brother's death, and upon his head be his brother's blood.

A NEW MINE TACHYMETER.

The accompanying cut illustrates a new Patent Mine Tachymeter, made by C. L. Berger & Sons, of Boston, Mass. A short description, showing briefly the steps which led up to this complete instrument for solving all problems in mine work, may prove of interest. The transit, as hitherto used for mine work, was distinguished principally from the Engineer's transit in that it had a full vertical circle to measure



vertical angles in the vertical plane. However, on account of the horizontal circle, vertical angles could not be read lower or higher than 60 or 65°. This first necessitated attaching a diagonal eye-piece which then enabled to read 75° angles, and in some exceptional cases, 90° angles. The latter necessitated raising the standards out of proportion to the size of the instrument and interfered with its stability. The next improvements for reading angles in the vertical plane and taking sights on objects in the full sweep of the vertical plane was by mounting the main telescope eccentrically, i.e., mounted on the outside of the standards; and many makers do so to-day. This allowed full sweep in the vertical plane, but when used for horizontal angles, it was necessary to allow for the eccentricity or to use offset measurements equal to its eccentricity. It will be readily seen that this was not thoroughly successful as when using the telescope in the centre of the instrument. The next form was to mount an auxiliary telescope, in addition to the main telescope at the side. This was an extra feature to surmount the difficulties in reading vertical angles. However, in measuring horizontal angles, when one point is away down and the other away up, the side telescope required offsets as just mentioned above, which prevented many engineers from its use, and besides on account of its unstable character as then made was not always satisfactory. On this account, some engineers preferred to have the auxiliary telescope mounted on top of the main telescope, and C. L. Berger & Sons made numbers of them. Then the top telescope placed in the same vertical plane by two "Y" standards attached to the main one would enable the operator to measure horizontal angles with accuracy differing only in degree of accuracy from the main one on account of the low power and general optical deficiencies of the auxiliary telescope, as compared with the main telescope. While this device proved satisfactory, particularly in stability, it could not be considered as being just the thing desired, since only a short telescope could be used, thereby impairing the degree of accuracy in reading the horizontal angles when longer sights were taken. However, to make the adjustments of the top telescope truly parallel to the main telescope, this auxiliary telescope had to be mounted on "Y's" fastened to the main telescope, but to make the adjustment of the line of collimation of the auxiliary telescope to lie perfectly in the same plane with the main telescope was a most arduous operation for the instrument maker, and therefore on the instrument makers' part not a desirable one to make. For this reason this

firm changed this mode of mounting the top telescope on two standards attached to the main telescope revolvable as in "Ys," and succeeded in attaching it on a central post in the centre of the axis and adjustable by a trivet so that the line of collimation of the telescope would lie truly parallel with the main telescope. Of this device a number were made for parties, as shown in their catalogue, and described under style II. auxiliary telescope. With this introduction horizontal angles could now be measured with a larger auxiliary telescope and with perfect accuracy.

At first it seemed impossible to make a reliable auxiliary telescope that would be true at top and side without an adjustable trivet until they soon found that the auxiliary telescope would need but one sighting wire, for if at the top, the vertical wire would be used for horizontal angles, and at the side will become the horizontal wire for reading vertical angles, and that therefore no adjustable trivet would be needed. They were now ready to make an auxiliary telescope without an adjustable trivet, that is, one simply mounted on a central post as in their former top telescope, but now interchangeable for top and side, permitting to make this device in the simpler form illustrated above.

The features of the top telescope were patented and the auxiliary telescope, as made to-day, contains the same patented features and no doubt has served to elevate the degree of accuracy in mine work to a very great extent.

In the accompanying cuts, Berger's Mine Tachymeter is shown used in various ways with the style I. interchangeable auxiliary telescope attached. This instrument is equally well adapted for surface or for underground work. This tachymeter has been especially designed to meet the difficult problems in mine surveying, and is made in two sizes.

Figure 1 illustrates the transit with a reflector attached at object end of telescope for illuminating the cross wires.

Figure 2 illustrates the patent style I. auxiliary interchangeable telescope for use on top or at side for sights inaccessible to the main telescope. This auxiliary telescope may also be used for making solar observations by using their solar equatorial adapter.

Figure 3 illustrates style I. auxiliary telescope attached at side for taking vertical angles.

Figure 4 illustrates the style I. auxiliary telescope attached at top for taking horizontal angles. When attached either at side or top, this auxiliary telescope is brought quickly and truly parallel to the line of collimation by two opposing screws mounted on a clamp ring, which attaches the auxiliary telescope to the stud.

Figure 5 illustrates plumbing from a point above the instrument by having a centre punch mark on telescope directly above the centre of the instrument.

Figure 6 illustrates the Berger short focus lens attached to the transit telescope for taking short sights in mines and tunnels. No. 1 lens enables taking sights from where the instrument focus leaves off, say at 6 feet to about 3½ feet. No. 2 from 3½ feet to 2½ feet, and both together to about 2¼ feet from centre of instrument.

Figure 7 illustrates the counterpoise for the auxiliary telescope.

Figure 8 illustrates two diaphragms, one having cross wires and the other stadia and diagonal wires. Both are mounted on the same diaphragm and by slightly turning the eye-piece either set may be brought into focus. This is known as the disappearing cross and stadia wire diaphragm. However, it is now customary with them to mount the two sets on one diaphragm, permanently in view, as the diagonal wires serve to distinguish the centre horizontal wire from either stadia wire.

Figure 9 illustrates the method of carrying the mine tachymeter and packing case enclosed in a leather case with shoulder straps, thus leaving both hands free for use when climbing ladders in mine work.

Extensive deposits of coal have been found on the island of Spitzbergen. This may have an important bearing on Arctic exploration, as deposits of fuel so near the base of operations must prove of great value.

GERMAN HIGH-SPEED ELECTRIC RAILWAY.

By O. Lasche, Chief Engineer Allgemeine Elektricitats Gesellschaft.

(Concluded from last issue).

THE MOTORS.

Each of the four motors is adapted for a normal output of 250 horse-power and a maximum output of 750 horse-power. The speed of the motor is about 960 r. p. m., enabling the car to run at a speed of 225 km. (140 miles) per hour. The tension of 12,000 volts taken from the overhead wire is reduced

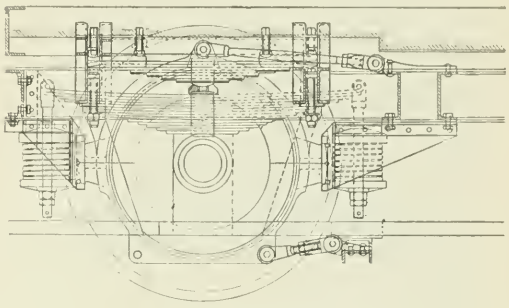


Fig. 7—Motor Mounting.

in the transformers to 435 volts. This voltage was adopted so as to permit of constructing the motors with a bifurcated winding (Fig. 3). Although the motor, as above stated, is not subjected to a hammering action, it was nevertheless deemed advisable, for permanent safety in working, to have only one single bar in the separate slots of the primary, instead of a number of wires insulated from each other by a cotton covering. The insulation of the bars against the iron is effected by closed micanite tubing. In the same manner as the field winding, the armature or secondary winding is also constructed as bifurcated winding. In consideration of the starting apparatus

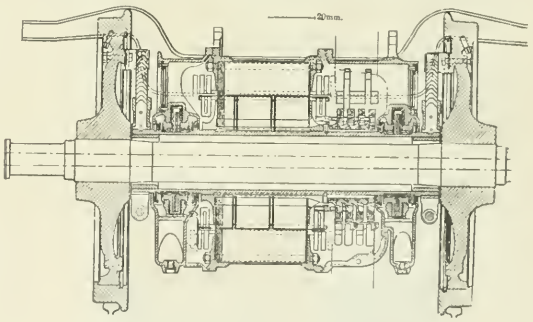


Fig. 8—Cross Section of Motor Mounting.

and cable arrangement, the armature was wound with only two phases and not, as usual, with three phases.

The casing (Fig. 8), carries by means of two bearings the hollow shaft on which the armature body is built. One of these bearings (Fig. 10), carries in its top half the brush apparatus of the slip rings and the connections for the cables of the armature circuits which lead to the regulating apparatus. The cables of the primary circuit are passed through the other bearing. The bottom halves of the bearings can be easily removed, and allow of the removal of the brasses and also of free access to the brush apparatus. Fig. 8 illustrates the journaling of the hollow shaft, and shows the manner of oiling the bearings. The oil level is located very high, so that when the motor is at full working condition the disk, which has to lift the oil, still dips therein to a depth of 30 to 40 mm. (1 to 1½ inches). The material for the bearings is white metal of the alloy usually adopted for the Prussian State railways. Nickel-steel was adopted for the hollow shaft, both on account of its polishing qualities and the high degree of solidity or

compactness of the material. The radial distance between this hollow shaft and the axle is 30 mm. Copper rings are forced into the hollow shaft at both ends close to the hubs of the wheels. The hollow shaft is prevented from lateral displacement by one of the motor bearings; a guiding motion against only one of the bearings is adopted, so as not to produce, owing to heat and expansion of the material, a seizure between axle and bearing. The spring couplings are fixed on to the hollow shaft at both ends. The object of this coupling (Fig. 9), is to transmit the torque of the motor—750 horse-power maximum at 960 revolutions—from the hollow shaft to the wheels,

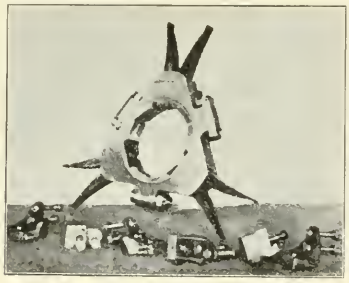


Fig 9—Motor Coupling.

thereby allowing the latter a displacement against the coupling arms to the extent of 10 mm. (⅜-inch). To allow of this the arms must be elastic, and, moreover, the spring heads must slide against the guides mounted on the wheel. The construction of the whole required a division of the coupling into three parts, corresponding to the three double arms. The springs are built up securely in the annular pieces by wedges, in such a manner that the tension of the wedges is further increased by centrifugal force. Furthermore, the plates are laterally extended within the hub and thus secured against flying out. The hub portions are of forged steel, the strain on the material therefrom being very favorable. The transmission of the power from the hollow shaft to the three-part hub of the coupling is effected by interposed springs.

TRANSFORMERS.

As to the transformers (Fig. 11), it may be added that the three cores are arranged side by side in accordance with the practice of the A. E. G. The axis of the cores is placed longitudinally in the car. In conformity with the transforming ratio of 12,000 volts to 435 volts, the inner low voltage winding is arranged as a massive copper spiral, and the high voltage winding separated therefrom by a micanite cylinder. The iron cores are provided with a longitudinal slot, through which a strong current of air passes, in the same manner as

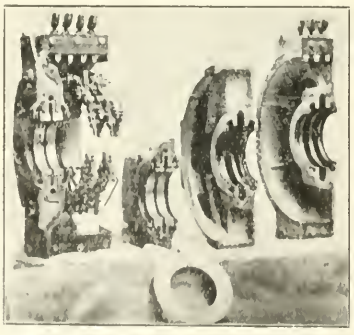


Fig 10—One of the Bearings

through the space between the square cores and the round coil. The air for this purpose is, as above described, received through large air shafts on the roof and delivered through channels to the transformers. For the removal of rainwater, a protecting angle iron is provided on the roof, and before the air centres the shaft and the channels it passes several times through a wide meshed wire netting; the air is then conducted over the transformer and filtered again before entering the cores. Notwithstanding these precautions, the air is only brought in direct contact with the interior of the cores of the transformer, and not with the current carrying parts. The cores are suspended in the middle of their length for the purpose of obviating any deformation due to the vibration of the car. The transformer is suspended to the body of the car by draw bolts, so that the lateral sheets are only used for lining purposes, and have no strain to withstand. Any further arrangement of springs against the body of the car did not appear to be of any use, because the present arrangement of springs is similar to that adopted for the "International" sleeping cars and ought to be sufficiently springy to ensure a long life for the insulating materials.

CABLES.

The current is taken from each of the three feeding wires by two bows in parallel. The upper part of the bow arms bears a number of aluminum rods connected to narrow plate springs. The weight of these single rods must be small enough to ensure a constant bearing against the wire. The head of the arm, which carries the above mentioned bow, is stamped out of aluminum sheet and connected to the vertical foot by rods, such foot being mounted by ball bearings in the casings secured to the car. By means of springs, the tension of which is regulated by cams, the bow is held against the wire. The current is conducted from the head of the bracket in insulated leads to the foot of the current-taking arms and transmitted therefrom through a contact to the cables affixed to the roof of the car. The bows are brought to touch the

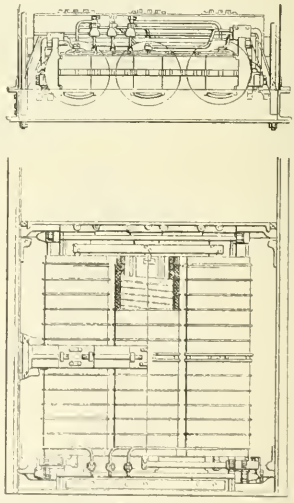


Fig 11.—Car Transformers.

wire and separated from the interior of the car, in such a manner that before getting on the roof the bows can be made free from current. All high-tension conductors are assumed as high tension cables, and have been subjected to an insulating test of 20,000 volts. Notwithstanding this fact, the conductors were treated as bare wires, and placed on high-tension insulators. Safety fuses are fixed close to the single bow. As soon as by some cause or other contact is made between any phase and the car put to earth, the car is made free from current by the melting of this fuse. The wires of both collector systems lead from the safety fuses to the high tension cut out. This cut-out is not necessary for the control, and serves merely for cutting off the tension at the end of the drive. The switch is operated from the apparatus room, or from either of the driver's cabs, thus serving as a safety switch in the event of the proper switch failing to act in case of an accident. The two branches of current pass separately from this main switch to the two transformers of the bogey. Each of these circuits and transformers is protected by fuses. The low tension conductors lead from the transformer through a

switching device to the motors. On account of the play to be allowed between bogey and car, both with the lateral oscillation when running round curves and with the vertical deflection due to the action of the springs, the cables had to be hung up flexibly, i.e., the cables are suspended and supported by a strong girth or belt. The cables, which lead from the motors back again to the starting device, are secured by a similar girth. The above-mentioned switch admits the current to the motor casings from the transformers, and it furthermore allows of the adjustment for either direction of the driving, or the delivery of counter current. Besides, the storage battery is connected from here to the primary circuit of the motors when braking the car as an automobile, i.e., when braking independently of the overhead wire.

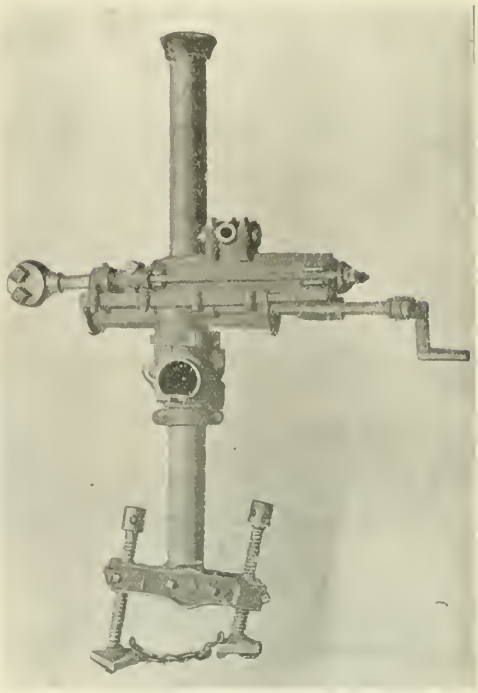
CONTROL OF THE CAR.

The car driver has to work only one single handwheel for carrying out all the operations. By means of an indicator, he can at any time ascertain the position of the apparatus, and by an amperemeter he can see the load on the motors. A further apparatus indicates continually the speed of the car. By the handwheel the driver operates a shaft extending through the entire length of the car. By a pair of bevel wheels and cam wheels the switch is operated from this shaft. The movement of this cam gearing to the extent of one tooth effects the switching of the controlling cylinder to forward current, counter current or braking action. The intermediate path, which the cam or gearing has to traverse, is used for operating the valve of the liquid starting device. Reference is made above to this starting and regulating apparatus, but it may be repeated that the driver is in a position to regulate the speed of the car from standstill to the full speed of the motors within suitable limits, and that he can also effect a starting and braking movement as quickly and as softly as may be desired. The liquid of the starting device is fed continuously by means of a centrifugal pump through a cooling coil system through which a current of air continuously passes and is thereby constantly mixed and cooled. On the left of the driver is the handle for operating the compressed air brake, and on his right is another handwheel for the hand brake for shunting service. Other measuring apparatus is proposed for the trials, especially for indicating the acceleration of the speed, for measuring the air resistance in the event of a head and cross wind, and also instruments for measuring and registering the consumption of current. In view of the novelty of the entire construction and almost every single part of the electrical equipment, and of the great responsibility which the constructor had undertaken, it was deemed advisable to make trials with the car stationary. Four trailing axles, each provided with two rollers, were mounted on heavy cast iron erecting plates, for the two-motor axles of a bogey. In view of the maximum circumferential velocity of 56 meters (183 ft.) per second, the rollers were made of steel casing and the bearing rims received the profile of the rail head. Wide, plain rims were provided laterally for putting on a brake strap, which, of course, had to be specially designed for the case in question, as also the rollers. The rollers are carried in plummer blocks, having white metal brasses. The speed of the rollers is 1,800 r. p. m. By this experimental arrangement, it was possible to run the motors of each truck up to the full speed. The weights required for testing the brake action of the motors and batteries were, unfortunately, wanting; the small weights of the motors and wheel sets cannot furnish sufficient proof as to the efficiency of the brakes. On the other hand, the experimental results of the brake action having proved so highly satisfactory, the braking system cannot be considered objectionable.

The great interest which the engineers of the whole world take in the development of the express railway has led to the publication of the above particulars. The question whether the speed aimed at will be fully attained depends partly on the car itself, and partly on the nature of the track. For gaining further experience on this point and also with regard to the consumption of power for the varying working conditions, time is still required.—Electrical World.

The Ontario mineral exhibit at the Glasgow Exhibition has been transferred to the Imperial Institute, in London.

MINING DRILL.

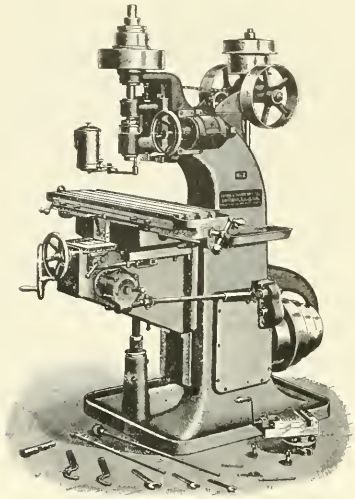


The above cut shows a mining drill made by the Dominion Rock Drill and Foundry Co. of Napanee, Ont., described in our September number. The drill is shown mounted on column and column arm. The makers of this drill are also manufacturers of other special machinery, including jewelers' and dentists' rolls.

VERTICAL SPINDLE MILLING MACHINE.

This type of machine is being more appreciated as the peculiar advantages it offers are constantly being better understood, and for many kinds of work is preferable to a machine with a horizontal spindle. Careful attention has been given in its design, not only to accuracy and rigidity, but to convenience and ease of manipulation as well. The use of a machine of this type permits the operator to more easily see the work, and more readily follow any irregularity in the outline of the work, as in profiling, cutting irregular slots in a surface and work of a similar character. All levers, hand wheels, etc., for controlling the various movements of the machine are conveniently placed, thus enabling adjustments to be quickly made. The spindle has a hole its entire length, and runs in bronze boxes, the bearings are ground and lapped. The lower box is provided with means of compensation for wear. With two speeds of counter, 12 changes of speed are obtained, as follows: Using main cone, 6 speeds, varying from 85 to 504; and using the high speed cone, 6 speeds, varying from 212 to 1,260 revolutions per minute. The lower end of the spindle has a No. 10 taper hole. The arbors and cutters can be held by a bolt passing through the spindle. Distance from the centre of the spindle to column 16 inches. The spindle head has a vertical movement of 4 inches, with fine hand feed, and quick return operated by the same hand wheel, often serving the purpose of a drill press on work already in position for milling. The spindle pulleys are carried on a separate sleeve, thus obviating any strain on the spindle due to the pull of the belt. A stop, with micrometer adjustment, is provided on the left side of the head for controlling the depth of cut. The cone has three steps for 3-inch belt. The table, including oil pans and channels, is 45 inches long, 10¼ inches wide, has a working surface 37 7/8-in.

by 10-in., 3 T slots 5/8-in. wide, an automatic transverse feed of 12-in., and can be lowered 16-in. from end of spindle. The elevating screw is of improved design and does not run below the base of the machine; the thrust is taken by ball bearings. The greatest distance from end of spindle to top of table is 20 inches. The feeds of table, longitudinal, 26-in.; transverse, 12-in., are positive and automatic in either direction, and can be automatically released at any point, or reversed by a simple movement of a lever on the front of the saddle. A lever on the right of the knee serves to reverse all feeds. There are 12 changes of feed in each direction, evenly graded from .005-in. to .125-in. to one revolution of the spindle.



Brown & Sharpe Vertical Spindle Milling Machine.

The change feed device, located inside of the upright, is simple in construction and positive in action. The changes of feed are obtained by unlatching and sliding a lever that sets the different combinations of feed gears. An index shows plainly the desired feed. The counter-shaft has two tight and loose pulleys, 10-in. in diameter for 3½-in. belt, and should run about 120 and 360 revolutions per minute. Weight of machine ready for shipment about 3,675 lbs. Net weight, about 2,800 lbs. Floor space, 88-in. by 69-in.

Circular Milling Attachment.

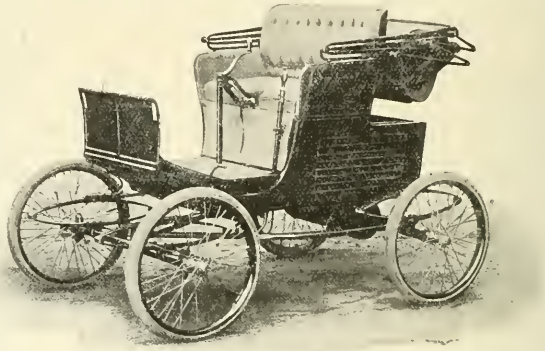
With this machine is a circular milling attachment which while designed for use on the vertical spindle milling machine, is found well adapted for use upon milling machines in connection with the vertical spindle milling attachment. The table is 18-in. in diameter, and has 4 T slots 5/8-in. wide. The circumference of the entire circle is graduated to degrees. The feed of table is operated by the hand wheel shown in cut. The worm can be thrown out of mesh and the table easily turned by hand. A clamp screw is provided for clamping the table in position.

This machine, with attachment, is made by the Brown & Sharpe Mnfg. Co., Providence, R.I.

A nickel claim has been located near the head waters of the Tulameen River. The deposit is thought to be extensive, and is the first found in British Columbia.

DURYEA AUTOMOBILES.

The J. Stevens Arms & Tool Co. are about to enter on the manufacture of automobiles at Chicopee Falls, Mass. The pattern carriage which they will turn out is the Duryea, the inventor of which is to be in charge of the works. The first lot of 50 will, it is expected, be placed on the market by March 1, 1902. The Duryea, or as it will hereafter be known, the Stevens-Duryea, will be equipped with a 5-horse-power double cylinder, horizontal motor, of the four-cycle type. The transmission will be by gearing, with three speeds and reverse.



Intermediate speeds can be secured by throttling the lever. The operation is simple. A prominent feature is that the machine requires no additional water for making a trip. With other machines this is a common fault. It is also guaranteed that the water will not freeze, chemicals being used as a preventive. Steam carriages are said to consume a gallon of gasoline in from 7 to 10 miles of travel, but the Duryea consumes but one gallon in each 30 miles. The success of the new carriage is believed to be assured, but the Stevens company are going moderately at the work, that the same thoroughness may accompany this as in the other branches of their business.

THE THEORY OF THE STEAM ENGINE—HOW MUCH OF IT IS TENABLE?

Editor CANADIAN ENGINEER.

It may seem like presumption for an obscure experimentalist to attempt the task of combating the concerted opinions of the many great and eminent minds that have been devoted to the study of the steam engine, and the writer fully appreciates the unenviable predicament of the iconoclast, who thus exposes himself to the indignant satire of outraged "Conservatives," who are always with us in the engineering, as well as in the ecclesiastical and political worlds. He is, however, sustained by the hope that these gentlemen may give him a fair, if impatient, hearing, and then proceed to demolish his arguments, before administering an equally well-merited fate to their unhappy author.

It is intended in this article to deal chiefly with the theory of cylinder condensation losses, and their supposed origin in the interchange of heat between the cylinder walls and the working steam at its varying degrees of pressure, humidity, and temperature, since these losses are generally recognized as the most serious of all in the application of steam power, and have led to all the expensive complications of compound and multiple expansion cylinders. Clearance losses have been discussed by the writer in previous articles, and he is pleased to note that at least one eminent and progressive thinker (Prof. Goss, of Perdue University), shares his views as to the fallacy of the popular theory of these losses.

Are there any other conditions under which such a weight of iron as that contained in the walls of a steam engine cylinder can be made to absorb or part with such volumes of heat in the tenth part of a second, which is the time required for one stroke of the piston at 300 revolutions per minute? As

these losses are said to occur chiefly during the initial exhaust the time must be still further reduced to at least the fiftieth part of a second. If iron is so susceptible to changes of temperature, how can we explain the fact that thin strips of the metal, when dropped into a pot of molten iron, are not instantly fusible, but require a perceptible space of time? They may indeed be suddenly immersed and withdrawn, say in one-quarter of a second of time, with scarcely any change of temperature. How then can steam at a fraction of the temperature of molten iron communicate a vastly greater volume of heat to cylinder walls, already raised to the temperature of boiling water, or how can they part with it in a fraction of this time? If it is contended that only a very thin shell of the cylinder wall is so affected, say to the extent of five or ten pounds of iron, how many heat units would be discharged therefrom, in a drop of temperature of 139 degrees, which is about the range of temperature in a standard locomotive cylinder using 180 pounds initial pressure? Such a calculation, if based on facts, would remove all doubt as to the extent of re-evaporation losses arising from this cause. It is certain, however, that no such drop in the temperature of the iron takes place.

The fact that water will boil in the open air more readily at high than low altitudes, is applied by some "Conservative" theorists, in a most illconsidered way, to the conditions existing in steam engine cylinders. They say that the boiling point of water depends upon the pressure, so that the water-vapor that continues to be water when the pressure is 180 pounds, or thereabout, at the beginning of the stroke, will flash into true steam at the point of release when the pressure has been reduced to say 25 pounds to the square inch. How are we to harmonize this statement with the fact that the entire volume of steam is evaporated in the boiler at the higher pressure? Evidently the boiling point of water also depends upon the volume of heat applied to it, and will only cease to evaporate under such high pressures and their accompanying temperatures when there is no space for steam to occupy. This condition of course, does not exist in steam-engine cylinders, and therefore re-evaporation takes place at the higher pressures, unless prevented by the work done in the cylinder, which consumes heat and produces water while condensation also and not re-evaporation is probably induced by the falling pressure and temperature at the point of release. There appears to be more than one serious leak in this time-worn theory. It won't even hold the water to which it relates. The experimentalists who have tried to establish it have evidently attributed effects to imaginary causes.

Everyone is familiar with the effect of water on iron to which heat is being applied. How can its constant application to cylinder walls fail to keep them practically at a constant temperature? Drops or streams of cold water, as every blacksmith knows, when applied to red-hot iron will boil or evaporate instantly, but thin pieces of iron when reduced to the temperature of liquid air and suddenly immersed and withdrawn from boiling water, show little immediate effect. Heat will readily flow from iron to water or aqueous vapor, but if the current cannot be as readily reversed what becomes of this interchange of heat theory? The practical economy of steam boilers is based on this law of heat, but if it were an equally reversible law, the losses from radiation would be enormous, and the frames and other parts of locomotives would become so hot that the drivers and firemen would need to be veritable salamanders to work on them.

The temperature of the cylinder walls is always very much lower than that of the initial steam, which is probably due to the fact that the greater proportion of the iron is never fully dry, and for this reason, also, never rises much above that of boiling water. How can it ever be much hotter than the water that wets it, since the heat, said to be interchanged, would necessarily have to pass through the film of water that clings to the cylinder walls, and which according to this miraculous theory, in alliance with other entrained water and vapor awaits its opportunity at the point of release, to dig into the iron walls of the cylinder and then fly out into space with an untold wealth of heat? It is extremely fortunate that the piston and its connections are larger than the port passages, or they would surely be kidnapped as well.

The film of water is probably removed from the walls and piston for a short initial space during admission, and the temperature of the iron raised to a higher but practically constant degree, although a slight interchange of heat may take place at the ends of the cylinder; but, in addition to this the water-laden residue of the exhaust is swept into the clearance spaces with every stroke of the piston, and initial condensation therefore remains the most serious loss in the standard cylinder. In compound and multiple expansion cylinders this evil is largely avoided, since the entering steam in all of the cylinders more nearly approaches the partially outworked condition of the products of compression, and the heat absorbed thereby is ready for work in the succeeding cylinders. Of course this would also be true of heat interchanged with the walls and pistons, if such interchange were possible, but the narrower ranges of temperature in these cylinders renders the application of such a theory doubly absurd as an explanation of still existing condensation.

If such changes of temperature do take place in the cylinder walls, how were the facts ascertained It is claimed that thermometers have recorded changes of a few degrees at very low speeds, but it is absurd to attribute such losses to such inadequate causes, nor are such data of any value whatever in calculating these alleged losses at higher speeds. It would also be utterly useless to attempt to remedy the evil by the use of steam jackets and lagged cylinders, as the internal losses would only be increased by the alleged higher temperatures, thus intermittently communicated to the cylinder walls, and alternately absorbed by the greater fall from the temperature at the point of release. It would merely be a substitution of internal for external radiation. External radiation, however, is known to be gradual and preventible by such means, which undoubtedly help to keep the internal walls also at a higher but practically uniform temperature. Testimony concerning the utility of steam jackets, moreover, is very conflicting. It is difficult to see how the gains can possibly balance the losses sustained therefrom. Initial condensation is probably reduced by the improved condition obtained of the material for compression, and the effective pressure may be slightly raised during expansion by the reduction in the saturation of the working steam, the cycle throughout transpiring at a higher average temperature: but the heat units thus expended are drawn from the boiler by a wasteful and cumbersome method, which also adds to the losses sustained from external and (during exhaust), internal radiation. Other well known difficulties and wastes are also encountered in maintaining efficient drainage of the jackets.

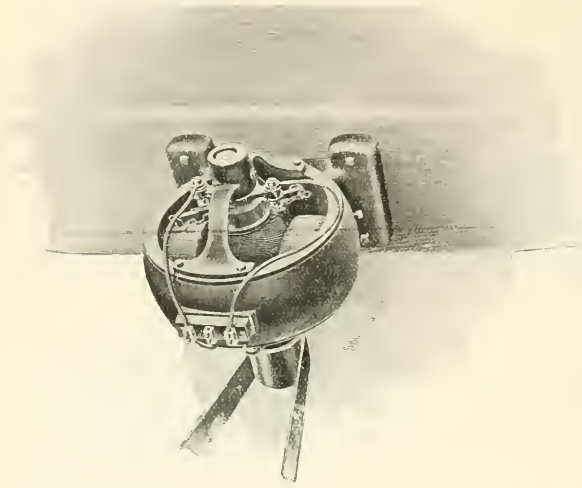
It seems more reasonable to attribute a portion of the economy shown by four-valved engines, to the fact that a larger volume of the aqueous exhaust is discharged from the bottom of the cylinder, thereby affording more adequate drainage rather than to its mere diversion from the live steam passages. During the exhaust these passages are filled with the same material that is being discharged from the cylinder, and the conditions remain unchanged in this respect by the use of the separate exhaust valves, except that no entrained water or vapor can be blown through the live steam passages, or retained in the cylinder by reason of the position of the outlet. The saving in initial condensation for this reason is evident, but the passage-cooling theory, as a corollary from the interchange-of-heat-theory appears to require further evidence to support it.

This venerable old theory is clearly untenable, and it is time for 20th century engineers to abandon such an absurd fallacy. It is doomed to take its place in the vast scrap-heap of false theories, piled up by doubt and science, where it will find worthy companionship in the ancient delusions of flat worlds and revolving suns. Internal radiation in steam engine cylinder is probably a continuous source of trifling losses, but cannot be to any extent comparable with external losses. It is certainly suspended during some portion of the stroke where compression begins and expansion is partially completed; but the heat is gradually absorbed, and as gradually disbursed, and there is no dancing of the temperature of the iron walls of the cylinder in harmony with the strokes of the piston. It is water that absorbs the heat, directly from the live steam and carries it out in the exhaust.

W. F. Cleveland.

A NEW BI-POLAR STURTEVANT MOTOR.

In the development of the bi-polar type of motor as especially adapted for direct connection to centrifugal fans, the B. F. Sturtevant Co., of Boston, Mass., has gradually been led into the manufacture of the same general type as independent motors. They of course possess the inherent feature of great range of speed due to the bi-polar design. In the accompanying illustration is shown one of these machines, which are built in small sizes ranging from ¼ to 5-h.p. The frame or magnet ring is usually of cast steel to support the armature bearing cradle. The stand or base is an entirely separate casting in which the motor is placed and secured by



set screws. Evidently the motor itself may therefore be turned to any angle, while the bearing cradle is maintained in a horizontal position. The bearings are of the ring oiling, self aligning type, the bearing sleeves being made of hard composition. This feature of having both bearings mounted in one and the same casting insures absolutely perfect alignment, while this feature combined with the ring oiling, self adjustment design insures the minimum friction resulting from rotation of the armature. Crucible steel is employed in making the shaft. The armature itself is of the ordinary toothed drum type, the coils being wound in slots being insulated in a most thorough manner. The commutator is built up of drop forged segments of pure lake copper mounted in composition shells and insulators with pure amber mica carefully selected. After being wound the whole armature is thoroughly saturated with an insulating compound, and baked at a temperature of from 150 to 175 deg. This renders the armature oil and water-proof, and prevents any liability of a break-down. The field coils are of durable cotton covered wire, which after being subjected to the same dipping and baking as the armature, are carefully covered with micanite paper and heavy tape. This is in turn given an external finish of oil and water-proof paint. Carbon brushes only are used, mounted in a socket type of holder, and provided with every facility of adjustment. Ordinarily these motors are furnished with V-slide rails in all sizes except the ¾ and ¼, but when it is desired to attach the motor to wall or ceiling, and have provision for tightening the belt, a special sliding base is furnished. These motors at standard speeds can be wound to any voltage up to 600 and will carry their full rated load for 10 hours with a temperature rise not exceeding 40 per cent. above that of the surrounding air, and without sparking. Evidently motors with these provisions for adjustment can be used equally well for the floor, wall or ceiling.

At the Shoe and Leather Fair in England the advantage of American machinery was evident. The manufacturers declared Britain to be twenty years behind.

THE GREAT DAM ON THE NILE.

The Assouan dam, says Engineering, is a solid wall of granite masonry, pierced by 140 under sluices of 23 feet by 6½ feet, and 40 upper sluices of 11½ by 6½ feet. The total area of waterway is 24,000 square feet. The greatest height of dam will be 130 feet, and the final head of water will be 85 feet. The maximum flood of 475,000 cubic feet per second will be discharged at a velocity of 20 feet per second, and ordinary floods at a velocity of 16 feet per second. Of the openings, 110 will be lined with granite ashlar, and 30 with cast iron. The regulation will be performed by Stoney's self-balanced roller gates.

ROBERT MUNRO.

Robert Munro, the newly elected president of the Canadian Manufacturers' Association, managing director of the Canada Paint Company, is a native of Glasgow, Scotland. His business career commenced with the firm of Alexander, Fergusson & Co., of that city in 1857, immediately following upon the action of that company in sending the late James Robertson to Canada. During subsequent years this firm have had large Canadian interests. Mr. Munro's first visit to Canada was in 1865, and the visits have been repeated at various intervals from that time until the amalgamation of the paint interests in 1892, which led to his settling in this country

SOMETHING ABOUT WIRE NAILS.

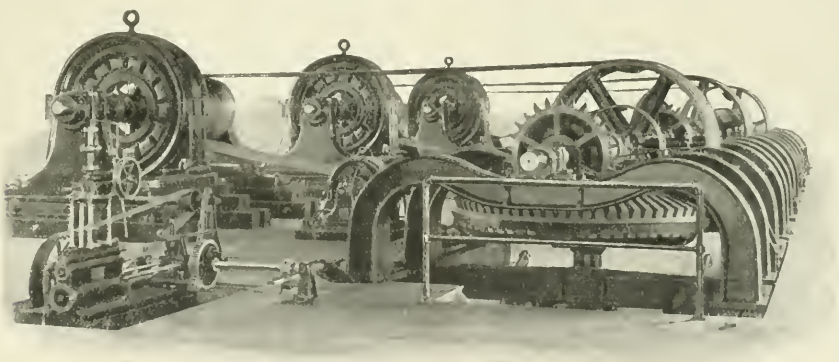
While the wire nail business has grown to such vast proportions in a comparatively few years, and in view of the fact that a mighty trust controls the price and output in the United States and Canada, it may be interesting to know that the honor of building the first wire nail machine in America belongs to the Pillow & Hersey Mnfg. Co., of Montreal, Canada. This company built one machine from drawings furnished by a Frenchman in the year 1870. Since that time, and especially during the past fifteen years, the growth of the wire nail business has been phenomenal. Eight million kegs of wire nails are made in the United States and six hundred thousand in Canada per annum. More than three thousand wire nail machines are required to produce this enormous quantity; and the value of the finished product reaches the tidy little sum of fully twenty millions of dollars per annum. A. Field & Son, tack manufacturers of Taunton, Mass., followed Pillow & Hersey by building six machines, and since that time to the present, the business has advanced to its present gigantic proportions. For many years the cut nail and the wire nail manufacturers fought for supremacy, but in the end the wire nail superseded the cut nail, to a great extent largely due to the introduction of cheaper raw material, finished wire, and improved machinery. Only a few years ago machines that made 500 lbs. of 2½-in. nails in ten hours, were considered good enough, but there are machines

now making 3,000 lbs. in the same length of time. G. P. Clapp, superintendent for the Pillow & Hersey Mnfg. Co., of Montreal, has invented a wire nail machine that makes three nails at each revolution, runs 350 turns per minute, and makes 1,050 perfect nails in the same length of time. One operator and two boys run ten of these machines, and turn out from 500 to 700 kegs of nails in 22 hours. These machines are patented in the United States and all important countries of Europe. Up to the present time multiple machines were not considered a success, greatly due to variation in the sizes of wire. With the Clapp machine this difficulty has been overcome by introducing a powerful gripping device and a feeding appliance that operates each wire independent of the other. By this method considerable variation in the sizes of wire may be permitted without interfering with the production of perfect nails. The Clapp machine is practically three rapid running machines combined in one. Wire nails were made in Europe for many years before being introduced into this country, but American enterprise and ingenuity have brought the business to such perfection that all other countries have been left hopelessly behind.

HYDRO-ELECTRIC PLANT AT SWAN FALLS, IDAHO.

Early in April of this year the Trade Dollar Mining Company, of Silver City, Idaho, put into operation a large waterpower plant from which power is derived for operating the machinery of the company's mine. On account of the scarcity of wood in that region and the high price of coal, the mining company found it necessary to secure a cheaper method for the generation of power than the use of steam.

After a thorough investigation of the various water courses in the vicinity, it was decided to utilize the waters of the Snake River at a point known as Swan Falls, this site



being the best for the construction of works for the development of the power. At this point the river has a low-water flow of 7,000 and a high-water flow of 70,000 cubic feet a second. The falls are caused by a dike of lava, which extends across the river. There is an island in the centre dividing the river into two channels, each about 450 feet wide. The right channel was entirely closed by a masonry dam of which the power house is a part, and in the left channel was built an overflow weir, with its crest at such a height as to give a working head of 17 feet on the wheels.

The power house is over the deepest portion of the right channel. Three belt-driven Westinghouse generators are operated from a jack-shaft, which is driven by four vertical-shaft 72-inch McCormick turbines, as seen in the accompanying illustration. These turbines operate under a 17-foot head, developing a total of 3,600 horse-power. The generators are of 300 kilowatts each and deliver a current of 500 volts which is stepped up to 22,000 volts. The gates of the four turbines are operated by a type B Lombard governor, which works in connection with a lever gate hoisting device, thereby dispensing with gears used in ordinary practice. The transmission line is 27 miles long to the distributing station and is three-phase with 50 poles to the mile. Glass insulators are used and not a single insulator on the line has been found defective. Since its formal opening on April 10th, the plant has been running continuously 24 hours a day.

The entire outfit of turbines and machinery, exclusive of electrical equipment, was built by the S. Morgan Smith Company, of York, Pa., for the Trade Dollar Mining Company.

MULTIPLE TELEGRAPHY.

What is considered the perfection of multiple telegraphy has been demonstrated in a series of experiments between Paris and Bordeaux. The apparatus was invented by M Mercadier, one of the head masters of the Paris Polytechnic School. No difficulty was found in transmitting on the same wire sixteen messages at the same time, and receiving an equal number without the slightest confusion. M. Mercadier has explained his system before the Academy of Science. "It is based on the principle of using undulatory currents," he said, "instead of continuous, its well known movements transmitting themselves in undulations that co-exist without destroying one another. Every drawing-room illustrates this —the voices of the different talkers, the sounds of a piano, and other noises not interfering in the slightest degree because they are undulating as well as pitched in different keys.

"Thus I have used a number of transmitters, each accorded to a different note in the scale, and therefore making a different number of vibrations. The first transmitters were tuned to G, the second to A, etc., each vibration sending a short, sharp current over the wire. A corresponding apparatus is placed at the receiving end, each responding only to the similarly tuned transmitter. In other words, messages fly along amicably and distinctly on a single wire precisely as conversations cross one another in the same room."

M. Mercadier added that his apparatus could be established at any point on a wire, and was perfectly capable of sending messages in different directions, the number being limited only by the number of pitches employed.

It is said that Klondike mine owners will return to winter mining, as confining themselves to summer work has not proved satisfactory. The output for the past season will amount to about $20,000,000.

James Douglas, LL.D., New York, president of the American Society of Mining Engineering, and a trustee of Queen's University, gave a lecture to the students of the School of Mining at Kingston recently. He spoke first of the wide range of knowledge which modern conditions render necessary for the mining engineer, and urged that a new chair of mining economics should be established in the school. He then gave the students a number of valuable rules, drawn from his own experience, as to their conduct in the profession they had chosen. "You will be exposed," he said, "to temptations far greater than those which beset the ordinary man. One rule I will give you, never under any circumstances accept a contingent fee." He also warned them very emphatically against giving any support whatever to the attempts of unscrupulous promoters to gull the public.

Industrial Notes.

A New York gentleman is talking of establishing a beet sugar factory at Peterboro.

Berlin ratepayers have passed the by-law giving a bonus of $20,000 to a beet sugar factory.

The Sayward Mill Co. has commenced the manufacture of sash and doors in Victoria, B.C.

The Perth peat works are having their capacity doubled, and a new engine is being put in.

A. R. McLennan's saw mills are being removed from Elm Bay to the Nugget river, Wabigoon.

Palmerston has had 50,886 feet of granolithic sidewalk laid this season by Mr. Lloyd, contractor.

The Consumers' Gas Co., Toronto, have laid a pipe to the island to supply gas to the residents there.

The Intercolonial Copper Co. has commenced the manufacture of sheet copper at its works, Dorchester, N.B.

E. B. Eddy has purchased at auction, two timber limits north of Lake Superior, for which he paid $303,000.

Prescott has been asked to grant a free site and a loan of $5,000 to a glove factory that would employ 25 hands.

John Maw, of Winnipeg, has given an order to a Toronto Junction firm for 1,000 plows, 500 to be delivered by March 1.

Several beds of asphalt said to be equal to the Trinidad article have been found in Michigan, not far from Escanaba.

The Parry Sound Lumber Co. has in contemplation the erection of a box factory which will employ about forty hands.

The boiler in the Norwood cheese and butter factory exploded a few days ago, wrecking the building and killing one man.

The Lehigh Portland Cement Co. gave passes for nine of the Hamilton aldermen from Buffalo to New York, and they took a trip to see the works of the company.

Sir Christopher Furness, after visiting Sydney, expressed his conviction that steel can be manufactured cheaper in Nova Scotia than in England.

A stone bridge has been built across the Mississippi at Pakenham, Ont., consisting of five arches of forty feet each. It replaces the old wooden bridge.

When navigation closes, over a quarter of a million tons of coal will have been brought to Fort William this season. This is 80,000 tons more than last year.

The Imperial Syrup Co. has withdrawn from Vancouver, and will concentrate its business in Montreal. Ramsey Bros. take over the British Columbia business.

The county of Lanark is evolving a plan to build a system of good roads through the county under the Ontario Act of last session. It is proposed to spend $120,000.

Canadian lumber is in demand for car and ship-building in the eastern States. A ship is on her way to take a cargo of over a million feet from Vancouver to Philadelphia.

It is stated that the tube works, in which F. H. Clergue is interested, are to be located on the United States side of the Sault. The plant will cost about a million dollars, and 600 men will be employed.

The Cleveland-Sarnia Saw Mills Co.'s mills at Sarnia have been started. They have a capacity of 125,000-ft. per day, which will be increased. Mr. Coleman had charge of their construction.

Machinery has arrived from the Krupp works in Germany for the Sun Portland Cement Works, Owen Sound. The Grey and Bruce Cement Co. have ordered their machinery from the same firm.

Prof. Gorham, of Brown University, U.S., is seeking to find an artificial light in which the element of heat is not contained, and believes he is on the road to definite results. He has succeeded in extracting from a decayed porterhouse steak sufficient illumination to take photographs.

Parties in Manitoba are making overtures to the provincial government to establish peat works if granted certain peat lands.

Almonte is being canvassed for stock subscriptions to the proposed binder twine factory. Mr. Bownell, of Toronto, is the promoter.

A new bridge across the St. John river, more modern ferry boats, automobile communication with the suburbs, and increased winter port accommodation, are being considered by the St. John, N.B., city council.

The Dominion Iron and Steel Co. is to proceed at once, says a Sydney paper, with the construction of a rolling and plate mill. It and the blooming mill, which it adjoins, will be over one-third of a mile long.

The Toronto city engineer has recommended tar macadam for residential streets on which there is no heavy traffic. There is only one street so paved in Toronto, but three more are to be done.

The dispute between the Lloyds and the Sturgeon Falls Pulp Co. has again been settled. The company will now push the mill to completion and intend to turn out from 100 to 120 tons a day.

H. L. Cooper, hydraulic engineer of New York, has selected a site for dams, power house, etc., for a 10,000-h.p. development on the Winnipeg river. The power is to be transmitted to Winnipeg. The point selected is at the junction of the Whitemouth and Winnipeg rivers.

The bridge over the St. Lawrence at Quebec has made rapid progress, and the Cap Rouge pier is nearly completed. The Chaudiere caisson will be constructed this winter. It is expected the bridge will be completed earlier than anticipated. The Montreal bridge will also be proceeded with.

The Ottawa Street Railway Co., the Ottawa Electric Co., Ottawa Power Co., The Bronson Co., and the Ottawa Improvement Co. are taking united action against J. R. Booth to prevent his building a dam at the Chaudiere Falls, on the ground that it will interfere with their water power.

The Keewatin Pulp and Paper Co., which holds a concession from the Ontario Government, will proceed at once with the erection of a large pulp mill at Cameron's Pool, on the Nepigon River, 12 miles north of Nepigon station. They are bound to develop 3,000-h.p within two years from 1900, and not less than 6,000-h.p. within four years in connection with pulp and paper mills, and may extend to 10,000-h.p.

The Blenheim News of Nov. 7th, after noting the objection to the payment of various accounts, in its report of the town council meeting, says: "A pleasant change was the prompt manner in which the Goldie & McCulloch Co.'s account of $2,829.50 for boiler, engine and fittings was passed, amid words of highest commendation by all the members for the manner in which that firm had carried out their contract. On motion it was decided to tender them a vote of thanks for the manner in which they had done their work."

The Goldie & McCulloch Co., Ltd., Galt, Ont., report trade good in all their lines. Besides numerous small shipments from their sale department last month, up to November 5th they have shipped a car-load of vault stuff to Golden, B.C., and a car-load of vault doors to one firm in Toronto. They have also orders for a car load of safes for Sydney, C.B. Other shipments are, a car load of machinery for Canada Woolen Mills Co., Waterloo, Ont.; one car load of tanks to Port Arthur; one engine to Toronto; one car machinery to Cargill, and much other small stuff.

The Freeholder is agitating for a change in the water pumping system at Cornwall from water power to electricity. An estimate has been made by Mr. Taylor, superintendent of the Davis works, which places the cost of installing a new pump and the necessary electric machinery in the present pump house at about $7,500, and the rate for power at $1,250 annually. At present the coal bill for the waterworks is about $3,000 per annum, and two men are required to attend to the plant. The change would effect a saving, according to The Freeholder's figures, of about $2,000 a year.

Bates & Robinson, plumbers, Toronto, have assigned.

An explosion at the Ottawa Carbide Co.'s works did nearly $10.000 damage, and killed one man and injured another.

The first cast in a new blast furnace of the Dominion Iron & Steel Co., recently blown in, amounted to 40 tons.

The sum of $17,000 is to be raised for a new pump and repairs to reservoir at the Niagara Falls, Ont., waterworks.

The improvements in the steam engine since 1870 are estimated to have reduced the cost of power more than 40 per cent.

It is rumored that steel works are to be established at the Chaudiere, Ottawa. Geo. C. Roe, manager of the Baldwin Iron Works is said to be interested.

Building improvements in Stratford this year amount to over $100,000. This includes the re-building of the Hodd & Cullen mill, and improvements in the Easson mill.

Messrs. Clayton & Costin, of Victoria, have received the contract for the placing of additional cold storage room for the Federation Cannery Co., at Steveston, B.C.

Sault Ste. Marie town council has resorted to legal proceedings against F. H. Clergue over the quality of the water supplied by his company, the Tagona Water & Light Co.

The Syracuse Smelting Works have secured a large order for Babbitt metal to be shipped to Holland. L. Sapery of this firm has returned from an extended trip through Europe.

B. Spragge, of Winnipeg, has contracted with the Vulcan Iron Co. to deliver 1,200 tons of scrap iron within the next six months. This is the largest contract of the kind ever made in the west.

The Government has made a contract with the Otonabee Power Co. by which the latter secures a lease of the power at No. 5 dam on the Otonabee river at $2 per h.p. The energy available is 625-h.p., but to obtain this the company will have to expend $100,000.

Acetylene gas, because of the brilliant whiteness and great steadiness of its light, combined with the simplicity of manufacture, is being carefully tested for lighthouse purposes. The tests have proved satisfactory. Italy has been giving special attention to the subject.

A by-law will be submitted to the ratepayers of St. Mary's in January to raise $30,000 for the purchase of modern road-making machinery and other requisites for permanent roadways. There may also be a by-law for the purpose of extending the street lighting system.

J. C. Wilson & Co., Glenora, Ont., have shipped to the town of Neepawa, Man., a 28-inch vertical "Little Giant" water wheel, and are now at work on the necessary gearing, shafting and other machinery required by that corporation in the improvement of their water and light plant.

A rumor having gone forth that it has been found that Cape Breton iron will not make Bessemer steel, because the coal contains too much sulphur and the iron too much phosphorus, Mr. Whitney and Mr. Moxham, of the D.I. & S. Co., give it an emphatic denial. The company, however, intend to make open hearth steel.

W. T. Jennings, C.E., of Toronto, who was employed to report on the water supply of Sydney, C.B., recommends pumping the supply from Middle Lake to a 54,000,000 gallon reservoir at Pat's Hill, at an elevation of 300 feet above sea level, thence to be carried by gravity through an 18-inch main. Pumps to be about same as those of the Dominion Iron and Steel Company, with daily capacity of 6,000,000 gallons. Cost of whole, exclusive of land approximately $200,000. This plan can for the present be reduced in cost $25,000 by leaving out the reservoir.

George Taunt and an English engineer are examining a number of properties in British Columbia, for a European syndicate, which includes a number of wealthy people in France. They propose to send over ten dredges, of a type which have done good service in New Zealand, to dredge for gold on these properties, which they own. They also propose to build a pulp mill at Vancouver.

Ridgetown has waterworks in contemplation, the supply to be obtained from artesian wells.

A new concrete dam is being built at the locks below Peterboro, on the Trent Valley Canal.

Tenders are invited for a combined traffic and railway bridge over the Fraser river at New Westminster.

The new Bauer coke ovens at Sydney Mines, have started operations. They consume 350 tons of coal per day.

The National Iron Works Co., incorporated last February, to establish works at Wingham, which voted a bonus of $17,000, has got into difficulties.

The Newbury branch of the Weidman Co., woodenware manufacturers, may be removed to St. Thomas, the timber supply at Newbury having given out.

The want of a method of controlling the water supply is felt in the Yukon. Since the moss and timber have been removed the winter snow melts and flows away before any considerable progress is made in the clean-up.

After being rebuilt and greatly extended by the new company, the Dartmouth rolling mills have been started again. They now have a capacity of from eight to ten tons of finished iron per day. Mr. Lissirmore is manager.

The School of Technology, Potsdam, N.Y., is now in its sixth year, and has made rapid progress. This institution celebrated Founders' Day on the 29th ult., when a number of Canadians were present. The new director is Prof. William S Aldrich, recently of Toronto, who during his short stay in Canada made many friends.

J. Alexander has bought out the interest of I. F. Moore in the engraving business formerly carried on by Moore & Alexander, Adelaide street west, Toronto, and will henceforth carry on the business under the name of The Alexander Engraving Co. Mr. Alexander has made an excellent reputation as a photo-engraver, and is now well equipped for carrying on the business.

J. C. Wilson & Co., Glenora, Ont., manufacturers of the "Little Giant" turbine, report that the demand for their wheels, still continues good. Among recent shipments are a 33-inch vertical to the Oxford Foundry and Machinery Co., Oxford, N.S.; one of a similar size to McBroom Bros., Washburn, Ont.; a 24-inch to Alex. McDonald, Melbourne, Que., and an 18-inch to an English customer.

The Penberthy Injector Co., of Detroit, Michigan, are installing a new 200-h.p. engine. This increase in their power plant has been rendered necessary by the remarkable growth of their business during the past year. The demand for their popular injector and other specialties has been so great as to require a large amount of additional machinery. With their new engine and additional lathes and other machinery which they have put in, they will have one of the best equipped plants in the United States for turning out their line of goods. They advise us that they will soon place on the market a low water alarm operating on a purely mechanical principle, also a positive force feed lubricator.

A settlement has been arrived at between the City of Toronto and the Fuel Economizer Co. The latter several years ago put in its economizer at the main pumping station of the waterworks. It was to cost $4,300 if it saved 6 per cent. of the coal consumed; more, if the saving were greater. There was a test, in which there was a suspicion of crookedness, and one civic official lost his job. Then the city told the company to take away its economizer. The company responded by suing for the purchase price. Another civic official took a trip to England to hunt up evidence. The compromise proposed now is this: The Economizer Co is to construct an $800 chimney at the pumping station. Then there is to be a fuel test without the economizer, and another with it; if the economizer saves 7 per cent. in coal consumption the city is to pay the purchase price for it; if the saving is less than 7 per cent., the company is to take away its economizer, and the city is to pay for the chimney, which it needs, anyway. Each side pays its own law costs. The city's share is about $500, to say nothing of the trip to England.

The commerce of the Dominion has increased 54 per cent., during the past 20 years.

Collingwood waterworks are being extended. A new dynamo is being installed of 2,000-c.p.

The Eclipse Mining and Milling Co., of Oskaloosa, Iowa, has been licensed to operate in British Columbia.

The Woodstock Wagon Co. may remove to Ingersoll, not being satisfied with their treatment by the former town.

An attempt is again being made in Vancouver to buy up the canneries on the Fraser River and combine them under one management.

In Windsor, Ont., several residents recovered damages from the salt works on account of smoke and cinders issuing from the works.

A scheme is on foot to bridge the St. Lawrence from Gananoque to Clayton, on the plan designated by French engineers as pontoon.

Dufferin county has decided to spend $66,000 for county roads. Of this sum $22,000 will be provided by the Government out of the $1,000,000 fund.

The Dominion Iron & Steel Co. has already sold a large quantity of steel billets to firms in the United States, to be delivered when their steel works commence operations.

Hamilton is not quite satisfied with its tar macadam streets. It is figured out that a first-class brick pavement could have been laid on York street for little more than the tar macadam has cost.

J. C. Gibson, formerly provincial boiler inspector, and late of the Stuart-Arbuthnot Co., Winnipeg, is about to establish a machinery business—new and second-hand, in all its branches—in that city,

It is reported that Mr. Janin, superintendent of the Montreal waterworks, has stated that it will take $300,000 to put the works in proper order, and that this expense will have to be incurred at once.

Smith's Falls has spent about $200,000 on waterworks, sewers, granolithic sidewalks and macadam roadways this year. There are about 6½ miles of sewer and water pipe, and both are laid in the same trench to save cost of excavating, as there is much rock.

A gang of Bell telephone cable operators and splicers have gone to Sault Ste. Marie to work for H. R. McLellan, who has contracted to deliver three hundred cords of hardwood a day at the side of the Algoma Central railway, where it will be loaded on cars for the Sault, to be turned into charcoal, and used in smelting iron ore. The method by which this wood is to be brought to the tracks is by a system of cable conveyers, and the men have gone to set these in operation.

The good roads train, which was at work in Eastern Ontario last summer, making sample stretches of road, did, among others, a piece of good work at Alexandria, on three-quarters of a mile, which was pronounced to be one of the worst pieces of road in the province. It was over an old swamp and had no foundation. When the machinery started work the earth for yards around quivered like jelly. The road was first thoroughly drained and then in the worst places stone put on unusually deep. The result is a first-class highway, on which heavy loads can readily be drawn. The total cost was $710. The good roads commissioner says fully 100 miles of good stone and gravel road have been built in Ontario this year.

West St. John will be a busy place this winter. It will be the terminal of the Allan Line under the new mail contract with the Government; the Elder-Dempster Company will run a fortnightly service from there to Liverpool, the Donaldsons a similar service to Glasgow, the Manchester liners a fortnightly service to Manchester, and the Head Line a fortnightly service to Dublin and Belfast. The Franco-Canadian Line may sail from this port, and as the Furness Line steamers sail from St. John via Halifax, the Canadian Pacific railway is building covered cattle yards capable of holding 1,800 head, extending its sidings and laying down additional tracks, while the Dominion Government has built a large immigration shed for 1,200 persons.

A brewery to cost $100,000 will be erected at Sault Ste. Marie.

Tilsonburg is trying to secure a new industry—the Maple Leaf Harvest Tool Co.

Oil having been struck at Tilsonburg preparations are being made to sink twenty more wells.

Wetzel & Pfeffer, Drayton, are about to place the latest type of roller machinery in their mill.

Gasoline engines are in great request in Manitoba for farm use. The manufacturers cannot meet the demand.

A system of compulsory inspection of elevators is to be adopted in Toronto. There are about one thousand elevators in use.

The Parry Sound Lumber Co. has built a machine shop, 48 x 60, for their own use, and the machinery is now being put in.

A flour mill is to be built at Oak Bank, east of Winnipeg. It will have a capacity of 200 barrels. An eastern firm are the promoters.

The Cape Breton door and sash factory has been sold to Aldred, Dimock & Shand, and will be moved from Sydney to Glace Bay.

The capacity of the Rat Portage Lumber Co.'s mills on Rainy River is to be doubled, giving them a capacity of 150,000 feet per day.

W. Taylor & Son, Carleton Place, will double the capacity of their tile works for next season. They manufactured 250,000 this year.

The Wire & Cable Company, of Montreal, have ordered a 300-h.p. compound engine from the Robb Engineering Company, Amherst, N.S.

Excavation work will be continued during the winter at St. Andrew's rapids on Red River, so that the stonework may be commenced in the spring.

The Goldie-McCulloch Co. is putting in a 450-h.p. engine and boilers in the elevator at Port Arthur. This is one of the largest ever erected in Canada.

The Robb Engineering Company, Amherst, N.S., has received an order for a 100-h.p. engine for the Government quarantine station, Grosse Isle, Quebec.

A metal trades council will be organized at Ottawa, in which the moulders, machinists, blacksmiths and pattern makers will have representation.

W. W. Cory, inspector of Government offices in the Yukon, speaks enthusiastically of the progress of that country. He says of Dawson that its streets are well graded, electrically lit, and it has a good system of sewers. About 100 miles of good road has been built in the territory this season. More mining machinery has gone in this season than ever before.

The Toronto City Commissioner says 325 extra tons of coal were consumed between April and November in the furnaces at the city hall. Of this, 199 tons were burned in an attempt to demonstrate that the city could light the building electrically cheaper with its own plant than by the purchase of power. Ninety-nine more tons were used to operate the ventilating apparatus for the county side of the building.

The Dodge Manufacturing Co., of Toronto, report a very satisfactory year. This company's works are constantly filled up with contracts from many lands for all kinds of power transmission outfits. Extensions are constantly being made at the Dodge Co.'s works, over 30,000 square feet of new shop area having lately been completed. The machine shops have been very materially increased. Some very heavy tools are being installed, all of the most modern type. Both the machine shops and foundry are being equipped with three motor electric travelling cranes. A feature of the new equipment is a 16-foot boring and turning mill, installed for the purpose of taking care of the Dodge Co.'s ever increasing trade in iron grooved wheels for Dodge system of rope driving. The company's shops are now equal to any of the kind on the continent.

Revelstoke will shortly take a vote on a by-law to raise $4,000 for street and sidewalk improvements.

Heney & Smith, of Ottawa, have been awarded the contract for harbor improvements at Father Point.

The Ontario Government is determined to stop the export of natural gas from the Essex fields to Detroit.

The Toronto Furnace and Crematory Company have completed the erection of a crematory plant for Winnipeg.

The Jacques-Cartier Water Power Co., Quebec, is putting in a steam auxiliary plant for use in case of a breakdown.

The C.P.R. are considering the enlargement of their coal facilities at Fort William from 200,000 tons to 500,000 tons.

Ontario's mineral exhibit at the Pan-American will probably be kept together at Toronto. The contributors have given their specimens to the province.

The new science building for Toronto University will be pushed on at once, the plans being ready. It will stand on College street at the head of McCaul.

It has been practically decided that a big cleaning elevator will be built at Fort William, and King's elevator at Port Arthur moved to Fort William probably next year.

Winnipeg city council will raise $50,000 to build and equip four fire halls and to purchase a dynamo and plant for extra lighting; also $64,174 for the extension of the waterworks.

Extensive repairs have been made in the Quebec waterworks. A new scouring gate and pipe have been put in at the foot of Charlesbourg Hill and a number of relief valves placed in position.

Work is to be commenced at once on Alexander & Law Bros.' flour mill at Brandon, Man. The mill is to have a capacity of 200 barrels per day with room to enlarge to 350 barrels.

The new Goderich summer hotel for which a bonus was voted is to be built by W. H. Smith, of Indianapolis. It will be a three-story brick veneer building, to accommodate 200 guests.

About thirty townships in Ontario will submit by-laws at the next elections to abolish statute labor. So far about 20 per cent. of the townships of the province have abolished statute labor.

The new mill of the Ottawa Milling Co., Ottawa, which is being erected, will be 90 x 66 feet, four stories high, to cost about $20,000. It will consist of a rolled oats and feed mill and a large elevator.

The British Columbia Government will take over the Similkameen bridge built by the Princeton townsite company on the condition that $1,500 is deducted as a contribution to the Copper Mountain wagon road.

The new Dominion Government dredge, King Edward, has been tested on the Fraser river at New Westminster. The trial was held under the supervision of A. W. Robinson, consulting engineer of the Government, who is the designer of the dredge.

John H. Jewell, the promoter of the Canada Steam Carriage Co., who proposed to establish automobile works at the Grant implement works, Grimsby, has been arrested for obtaining money under false pretenses in connection with his scheme. He has retaliated by entering an action for $10,000 damages.

The main building of the Pigeon River Lumber Co.'s mill at Port Arthur is almost completed and part of the machinery has arrived. It will be one of the most complete on the lakes. It is to be lighted by electricity furnished by its own dynamos, which will have a capacity of 400 lights. The plant will be put in by Mr. Harrison, of Winnipeg.

Among the largest private wire systems in the world is that of the Coe Commission Company, of Minneapolis, which has under construction a wire from Minneapolis to Helena, Mont. When completed the company will have 5,000 miles of wire. Winnipeg is connected with the system, which will soon be extended to Brandon and Portage la Prairie. The system is used for stock and grain quotations.

Electric Flashes.

Huntsville is having a new electric light plant installed.

The Sarnia Electric Railway is now extended to Point Edward.

The Brockville Light and Power Co. is going into liquidation, the town having purchased their plant.

The London county council has been asked to provide separate conveyances for women on the tramways.

It is rumored that the Quaker Oats Co. will take over stock and plant of the Peterboro Light & Power Co.

The long distance telephone line between Victoria and Nanaimo is about completed. The distance is 83 miles.

Jacob Morley is building a new electric power house at New Hamburg, in which he will place an 80-h.p. engine and boiler.

A telephone system operated entirely by Indians is being installed in the village of Kish-Pic-Axe, in Northern British Columbia.

The Vancouver Electric Railway Co. is preparing to build the extensions recently agreed on. They are to be completed by May 1.

The Sydney Mines town council has decided not to have electric lighting at present. The contractor's rates were considered too high.

A company proposes to build an electric car line between Stratford and Mitchell, 12 miles, and asks a 50-year franchise from the former.

An electric light plant is to be installed at Ferguson, B.C. The Lardeau Power & Light Co. have made the necessary arrangements.

Prescott is being wired for the new electric light system. Arc lights will be placed on the main street and incandescent lights on the others.

The cost of telephone service has been raised in Ottawa $5, with a reduction on a three-year contract for those using more than one instrument.

A proposed wedding by telephone between Chicago and Wichita, Kansas, has been called off, as the lawyers have declared it would not be legal.

The question of rapid transit has become so important that Winston Churchill advocates the appointment of a Secretary for Electricity and a Minister of Traction for Great Britain.

The Jenckes Machine Company, Sherbrooke, have the contract for turbines for the Current River power development near Port Arthur. The Bullock Electrical Co. have the contract for generators.

Lorne A. Campbell, of Rossland, has been awarded the contract for the erection of poles for the Cascade Power Co., from Cascade to Phoenix. John Copp, also of Rossland, has the contract for the erection of the brick building for the head works and power-house at Cascade.

A St. John tea firm has imported from England an electric automatic weighing machine, the first to be introduced in Canada. The machine weighs 1 lb. and 1½ lb packages of tea at the rate of 16 per minute. It saves the work of one boy at each machine, and ensures absolute accuracy.

At the annual meeting of the Eastern Telephone Company held at Sydney, N.S., the following directors were re-elected: R. A. H. McKeen, president; Judge Dodd, vice-president; J. E. Burchell, B. Archibald, J. R. Hackett, Capt John Lorway, W. Crowe, B. W. Chipman and Robie Uniacke of Halifax, were also elected to the board. It was decided to increase the capital from $50,000 to $150,000.

J. C. Wilson & Co., Glenora, Ont., have about completed work on the order placed with them for the improvements which are being made in the light and water plant of the village of Hanover, Ont. The machinery supplied by this firm consists of one 33 inch deep bucket, vertical, and one 21-inch standard bucket "Little Giant" turbine; steel penstock, 35 feet long, 45 inches diameter, with a Y connection at the wheels, and the necessary gearing, shafting, bearings, etc.

Hawkesbury proposes to acquire the electric light and waterworks plants.

The I. C. R. has decided to instal its own electric light plant at Sydney, C.B.

North Sydney ratepayers have decided against the town acquiring the electric light plant.

German trolleys between Berlin and Zossen will be limited to 97 miles an hour to avoid accidents.

New Glasgow is putting in an electric fire alarm system. A bell has been imported from England, weighing 1,500 lbs.

A company is being formed, principally composed of American capitalists, to build a line of electrical street railway at Levis. The town is also to have electric light.

Toronto is the third city in America in its use of the telephone. San Francisco is first with 1 in 16, Boston second with 1 in 24, Toronto, third with 1 in 25. There are 8,000 telephones in use.

The advantage of underground traffic came out in London during a recent period of fog, which lasted for several days. Traffic was almost entirely suspended on the streets, but on the underground it was not interfered with.

The arbitrators have fixed the price of the Kingston Light, Heat & Power Co.'s property at $170,370. Two of the arbitrators decide that the franchise under the agreement with the city is of no value. If on appeal the franchise is to be considered its value is placed at $80,000. The company when asked to fix a price before the arbitration, named $373,000.

The S. Morgan-Smith Co., York, Pa., has lately received an order for six single 39-inch and one 18-inch McCormick turbine from the Metabatchouan Pulp Co., Quebec. Each turbine will be mounted in an iron flume connected to a supply pipe 16 feet diameter. Five of the 39-in. turbines will develop 4,000-h.p., and drive 10 pulp grinders. Another of same size will drive the wet machines, screens and other machinery. The 18-in. will operate a dynamo; head, 46 feet. The mill will have a daily capacity of 60 tons pulp, dry weight.

The Jones & Moore Electric Co. have installed the following: A large electric lighting plant for the J. B. Smith Co., Toronto; an electric lighting dynamo for Messrs. Black & Davidson, St. Catharines; a 20-k.w. machine for the Kemp Mnfg. Co., Toronto; an incandescent light generator for W. McDonald, Morden, Man.: a lighting plant for J. A. Gould & Co., Kingston; a plating plant for Messrs. Cohen Bros., and A. E. Burgess & Co., of Toronto. Beardmore & Co. have also placed an order with them for one of their motors. They are enlarging their works in order to keep up with their largely increased business.

The Barton & Co. electric motor works, London, report the following recent orders filled by them. J. A. Williams & Co., Zurich, 300 light multipolar dynamo; Southam Printing and Lithograph Co., London, 20-h.p., 220 volt multipolar generator; Southcott Mnfg. Co., London, 3-h.p. motor; Kalbfleisch Bros., Stratford, 2 bi-polar motors; Breck & Halliday, Kingston, two 3-h.p. bi-polar, and two 10-h.p. multipolar motors; C. Turnbull Co., Galt, one 300 light multipolar dynamo; John Morrow Machine Screw Co., Ingersoll, one motor; Guymer & Co., London, one plating dynamo.

A cat climbed a trolley pole near Lockport the other day and caused a lot of trouble to the International Traction Company and the Niagara Falls Power Company. Puss tried to walk on the feed wire and her tail happened to touch the parallel wire that carried the current back to Niagara Falls. There was a flash that could be seen for miles as the 24,000 volts of electricity passed through her body. The cat was burned to a crisp. Her lifeless body fell across both wires, and did not drop to the ground. This short-circuited the current, caused a fuse to burn out at the Niagara Falls power-house and cut off the power from all the lines centring there. It was two hours before the cause of the trouble could be found and the charred remains of the cat removed from the wires. In the meantime almost all the electric railways and street lighting plants in western New York were without power.

The C.P.R. is said to have quietly purchased most of the stock of the Galt, Preston & Hespeler electric railway at par.

The Dominion Coal Co. has decided to substitute electricity for steam on its railway between Sydney and Glace Bay.

The streets of Merrickville are to be lighted by E. Kyle, for the sum of $660 a year. It is to be an all night service and the contract is for five years.

The new power-house of the Cape Breton Electric Co. will be at Sydney. Their whole system is expected to be completed next summer.

The Electrical Construction Co., of London, Ont, have removed to their large new works at 32-40 Dundas street, described in a former issue.

A telephone company in Indianapolis has engaged an elocutionist to give lessons in voice culture to its girls, who will be obliged to attend. It is hoped mistakes may thus be minimized.

The deal by the town of Almonte to secure control of its own electric lighting has been completed, and the town has come into possession. J. B. Wylie has been engaged as manager.

The Eastern Telephone Co. will reconstruct its system at Sydney, C.B., with a new building and metallic circuit for every subscriber. Rates will probably be raised when the improvements are carried out.

The St. John, N.B., city council asks 10 free telephones in return for the privilege asked by the New Brunswick Telephone Co., of laying its wires underground. Dr. Stockton, manager of the company, says the demand will not be met.

A new electric railway project is announced under the name of the Huron, Grey & Bruce Railway & Construction Company. The proposal is to build a line from Southampton, through Tara, Harriston and Walkerton, with branch lines to Stratford and other places.

An apparatus has been invented with three times the speed of the Morse system in telegraphing, and in the use of which no skilled transcription is required. Its adoption would cheapen the cost of telegraphing materially.

There has been a fight in the St. Catharines city council over street lighting contracts, and the electric light people won. The city holds stock in the Gas Company, nevertheless a tender from that company was rejected. The Standard says that some of the aldermen were suddenly converted, and hints that Montreal methods were employed.

It may not be generally known that there exists a branch of the Yukon telegraph line from Hazelton, on the main line, to Fort Simpson, 600 miles up the coast. As the latter is a port of call for all Canadian coast vessels, a vessel may be there overtaken by wire 40 hours after she has left Vancouver, and vessels bound south may send word from there.

The arbitration to determine the value of the Sturgeon Falls electric light plant, with a view of the town taking it over, has come to naught. John Parker, arbitrator for the town, withdrew, and Dr. L. E. Bolster, arbitrator for the Bremner Co., fixed the value at $10,580. Judge Valin, when appealed to, refused to enforce Dr. Bolster's award. The authorities at Sturgeon Falls say the plant is worth only $3,000.

Two interesting articles are on exhibition at the office of the Gas and Electric Light Co. at Sarnia. One is a patent meter with slot attachment. The householder drops in a quarter, turns on the light and when the light goes out drops in another. The other is a meter for electricity with a switchboard and a display of lights so that the consumer can see the meter in operation. The company is about to put in a meter in every building using current.

A firm of grain dealers in a town west of Winnipeg decided to open a store at a place seven miles distant. Soon the necessity for telephone communication became urgent. The expense of putting up poles and stringing a wire was too great, but someone noticed that nearly all the farms were enclosed with barbed wire fences, and suggested they might be used. Experiments were made, which proved successful, and now a long distance telephone is in full operation over the barbed wire fence.

Newcastle, N.B., is considering an electric light plant.

The Circuit Court at Baltimore has decided that an affidavit taken by telephone is legal.

A French inventor has discovered a means by which sixteen messages may be sent over one wire at the same time.

McGill College, Montreal, has received several machines, mostly electric measuring instruments, given by the Canadian General Electric, the Westinghouse and other companies.

The Cape Breton Electric Co. is to have a franchise to build an electric road through Glace Bay. This means that within a short while the industrial centres of Cape Breton will be belted by electric roads.

A new danger from the use of electricity has appeared. A number of passengers were taken ill on a Paris tramcar, and investigation showed poisoning from the action of sulphuric acid on the lead of the accumulators.

The Niagara Gorge Railway was without power one day recently, and a number of industries brought to a standstill by a fire which destroyed the tower in which the wires are carried from the gorge to the top of the cliff.

An American firm has introduced a very useful incandescent lamp hanger, on the principle of the spring roller shade. It can be attached to a ceiling, and will roll up automatically about 10 feet of the stiffest lamp cord, so that the lamp may be placed at any height desired without knotting the cord.

The Marconi system of wireless telegraphy has been installed at a number of points in the Gulf of St. Lawrence by the Dominion Government. The work was done by the steamer Tyrian, D. J. Keeley, superintendent of Government cables, being in charge, with Messrs. Newman and Platt, of London, representatives of the Marconi Company, on board.

The telegraph lines, operated by the Dominion Government, on the Gulf of St. Lawrence, for the benefit of shipping, have been extended eastwardly along the north shore from Baie des Moutons to Chateau Bay, on the Labrador shore of the Strait of Belle Isle, a distance of 247 miles, and a cable has been laid connecting Chateau Bay with Belle Isle.

A one rail railway is to be tried in New York, and a very great rate of speed aimed at. The cars will be cigar-shaped, and run upon a central rail on an elevated structure. The electricity will be carried in outer rails on the under side of the structure, connecting with the car by clamp wheels. These are bound to the track in such a manner that accidents, it is asserted, are impossible.

Several accidents from live wires are reported. A line repairer, at Prescott, named Fontain, was working on the electric light wires, when the current was turned on and he was electrocuted. At Brantford a trolley wire fell and a horse which stepped on it fell dead. At Niagara Falls, Ont., a trolley wire broke and fell in front of the car, enveloping it and the motorman in flames, but the car was fortunately a closed one and he and the passengers escaped. Too much care cannot be taken in putting up and keeping in order wires carrying heavy currents.

Speaking of the Armstrong-Orling discoveries, referred to in the last number of The Canadian Engineer, I. N. Ford, cabling from London, says: Without pretending that the new rival to the Marconi system is yet in a practical working state, he has heard the articulate human voice rising through a long spike in the ground, and ventures to forecast important twentieth century results with wireless telephones carried by men and women like cameras or card-cases, any gentleman of leisure being at liberty to switch himself on to the underground radiations through the medium of his walking stick or boots, while ships on the high seas may tune up as they sail, holding converse in ill weather, and roaring out their names and courses in the densest fog.

The Chicago city council has passed an ordinance requiring the railways entering the city to elevate their tracks. This means the elevation of 16 miles of track in six years at a cost of $2,000,000.

Railway Matters.

The Intercolonial Railway is building a new station at Levis.

The lines of the Canadian Northern railway east and west from Manitoba have been connected.

The bridge of the Canadian Northern Railway across Red River at Winnipeg has been completed for traffic.

Complaint is made that the C.P.R. is not running to the Place Viger station at Montreal the number of trains agreed upon when the city gave a bonus of $1,000,000 towards the erection of the station and hotel. A civic committee has been appointed to investigate.

Mackenzie, Mann & Co. intend to build a branch of the Canadian Northern through the northern part of Minnesota, south of Rainy River, which will capture a large traffic that would otherwise go to the Northern Pacific and Great Northern. This will help to build up Port Arthur.

The Lardeau branch of the C.P.R. is well under way, but it is probable its completion will be deferred till the spring.

J. W. Stewart, of Winnipeg, has been awarded a contract to lower some of the grades on the C.P.R. in the Rocky Mountains. The contract amounts to about $1,000,000.

The contract for 50 miles of the Cape Breton railway has been let to Lackie & Collins. The cost will average about $30,000 a mile, or a total of nearly $8,000,000. Upon its completion it is the intention of the promoters to construct mills and manufacturing establishments at Louisburg, the terminal.

The Rutland Railway has secured an entrance to Montreal over the C.P.R., forming a new line to New York. In addition to absorbing the Odgensburg & Lake Champlain, the Rutland has also purchased the Chatham & Lebanon Valley line, which runs from Chatham to Bennington, where it connects with the Rutland road, and with the Boston & Albany at Hoosie Falls, thus giving the Rutland a new entrance to Boston.

The Victoria Terminal Railway and Ferry Co. has bought the Victoria & Sidney Railway, which they are extending to the business centre of Victoria. They will also build a road from the terminus of the Great Northern at Liverpool to the mouth of the Fraser river, and ferry cars across the Gulf of Georgia. They have made a 25-year contract with the Great Northern. This will make Victoria a terminus of that road.

The semi-annual report of the Grand Trunk for the first six months of the year was recently laid before the Board of Directors. A comparison with the same period of 1900 is of interest. The gross receipts were: 1900, £2,139,691; 1901, £2,287 795. Working expenses were, 1900, £1,429,849; 1901, £1,531,261. Passengers carried, 1900, 3,001,414; 1901, 3,205,441. Average fare per passenger, 1900, 3s. 6d.; 1901, 3s. 5¼d. Tons of freight and live stock carried, 1900, 5,217,131; 1901, 5,613,613. Average rate per ton, 1900, 5s. 6d.; 1901, 5s. 6¾d. Earnings per train mile, 1900, 55.50d.; 1901, 60.35d. There has been an increase of 54 miles in the length of lines worked, by the addition of 1 mile caused by fractional readjustments, and of 53 miles by the leasing of the Cincinnati, Saginaw and Mackinaw railroad. The total mileage is now 4,915. The expenditure includes £9,658 3s. on account of construction of new general offices, Montreal; £22,990 1s. 6d. on account of the double track between Hamilton and Niagara Falls, and £13,882 12s. 1d. for the further equipment of engines and freight cars with air brakes, automatic couplers, etc. Of the total distance of 41 miles of single track between Hamilton and Niagara Falls, the double tracking of 25 miles from Hamilton to Jordan has been completed. The double tracking of the remaining 16 miles from Jordan to Niagara Falls will be proceeded with forthwith. With a view of further facilitating the movement of traffic, the directors have authorized the immediate laying of a second track from Port Union to Whitby, a distance of 11¾ miles, leaving only 34¼ miles of single track between Montreal and Toronto, the doubling of which it will be desirable shortly to accomplish.

The survey of the proposed Kitimat and Hazelton railway has been suspended for the winter. So far as carried out a good route was found through a fine country, much of which is heavily timbered with cedar.

Experiments are to be made with fuel oil by the Great Northern in the long Cascade tunnel, to determine the merits of assertions made by railway engineers that oil fuel keeps air in tunnels clear. Although the most improved system of fan ventilation has been applied, it is said to be almost impossible to keep the tremendous bore free from coal smoke and gases. It is planned to use in the tunnel heavy locomotives fitted with devices for burning petroleum. These are to be used on all trains through the tunnel, coal fire locomotives taking the trains as they emerge.

Marine News.

The Dominion Steamship Line has decided to place its fine new vessel Commonwealth on the route between Boston and the Mediterranean this winter.

The repairs to the C.P.R. steamer Hating, recently ashore on the coast of British Columbia, will cost about $22,000. The contract has been let to the Esquimalt Marine Railway Co.

Knapp's roller boat rolled from Prescott to Ogdensburg the other day, but ended up in a mud bank. Its inventor still has faith in the success of his boat.

W. Macpherson, of the Quebec Harbor Commission, points out that the employment of the largest steamers to make transportation cheap is the only way by which the lake and river route can be made a success. Quebec, he claims, is the natural port for transhipment for the largest craft that pass through the canals, as it affords an anchorage for the largest vessels afloat.

A seven-masted steel schooner has been built from designs by B. B. Crowninshield, of Boston. She is 395 feet long, 50 feet beam, depth, 34 feet 5 inches; has a sail area of 40,617 square feet, and a cargo capacity of 7,500 tons. She has fore and aft rig, and is fitted with steam appliances for hoisting anchors and sails, so that she can be worked by a crew of nineteen. The tendency has been of late towards this type of vessel and there are a number of five and six masted schooners in the Atlantic coast trade.

Prof. Emerson, of Ottawa, has just completed a torpedo boat, such as is used in the United States and Britain, and which, in place of being run by steam power, is manipulated by gasoline. The boat is 30 feet in length, much on the lines of a war canoe, and the motor, which is of 50-h.p., is situated amidships, with the gasoline tank under the bow. It gives 2,000 revolutions per minute, and will develop a speed of 26 miles an hour. The motor is of the hydro-carbon explosive type, with four cylinders, operated by eight valves. The main object of the boat is to obtain speed with a driving power, and one that is instantaneous, noiseless and smokeless, to give no evidence of its locality to an enemy.

The constitutionality of the Ontario Mines Act is doubtful, as it is regarded as an interference with trade and commerce. It has never been put in force, requiring an order in-council for that purpose.

Senator Campbell, connected with mining operations in the Cariboo country, has placed orders in San Francisco for a hoist to handle 10,000 lbs., and two water skips of 1,000 gallons each, for the Miocene Co.'s three compartment shaft at Harper's Camp, Horse Fly. The shaft is the deepest ever sunk in Cariboo.

McLean Brothers, Vancouver, contractors for the Chilliwack dykes and other large Government works, are interested in the construction of a railway line which will be built in the Klondyke next season, to carry supplies from Dawson to the mines on the creeks. The line will be twelve miles in length and cost $600,000.

Personal.

Matthew Beatty, founder of the Welland iron works, is dead.

G. S. Strevel, one of the oldest railway contractors in Western Canada, has retired from business.

Aemilius Jarvis, of Toronto, has been appointed secretary of the Niagara, St. Catharines & Toronto Railway Co.

John H. Housser has been elected a director of the Massey-Harris Co., in place of the late W. E. Massey. C. D. Massey has been elected president.

Engineer J. C. Beardsley, of the Cleveland waterworks department, was a visitor to Toronto on the 25th of Nov. Cleveland is installing 10,000 water meters.

Robert Surtees, engineer of the Ottawa Improvement Commission, will not proceed with the libel suit against The Citizen, it having apologized for the reflections made against him.

John M. Daly has been appointed general manager of the Cape Breton railway. He was formerly superintendent of transportation of the Delaware & Lackawanna and the Illinois Central railways.

Frederick W. Blaiklock, P.L.S., of Montreal, died on November 26. He was a son of Capt. Blaiklock, Royal Engineers, and was for 45 years engaged on surveys in the province of Quebec by the Government.

John Boulton, engineer of the R. & O. Co., is dead. He was at one time employed in the Kingston foundry, and latterly with the Bertram Engine Works Co., Toronto. He set up the engines of the steamers Toronto and Kingston.

Arthur Bolton, Toronto, civil engineer, who has been in Burmah for the past two years, disappeared off the Dominion steamship Commonwealth the day before she arrived at Boston, Nov. 26. He had malarial fever while in the east.

James Corrigan, the millionaire, who recently purchased Dry Island, near Morrisburg, and is preparing to build thereon a summer residence, worked as a boy on a hand pump, raising water for the Grand Trunk engines at Nash's Creek, east of Morrisburg. He and his brother went to Cleveland, where they made their fortune in oil refining.

Mining Matters.

A smelter is being put in at Marysville, East Kootenay.

Five thousand pounds of dynamite exploded at the Helen mine, Michipicoten. One man was killed.

The Dominion Iron and Steel Co. are said to be negotiating for the iron deposits at Gabarus Lake.

An immense bed of bituminous coal, extending at least 300 miles, is said to have been discovered near the Arctic ocean.

A smelter is to be erected at Osborne Bay, B.C., with a capacity of 300 tons a day. Fred. Sherborne, of Victoria, has the contract.

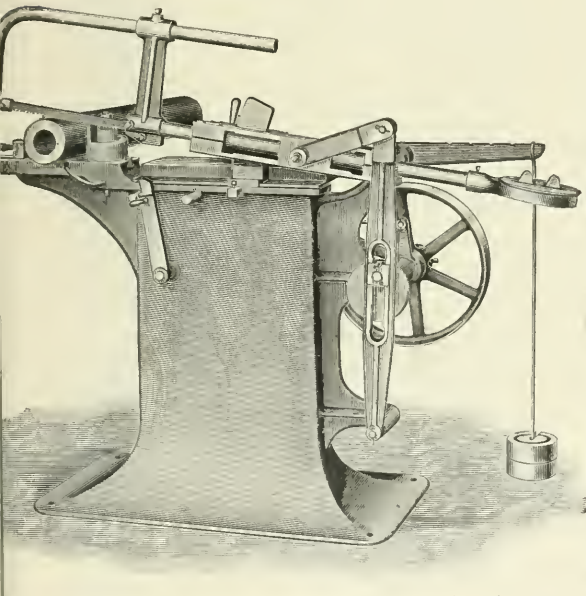
The Horne-Payne concentrator is to be removed from Laurie to the Payne mine, Sandon. Folliott & McMillan, of Sandon, have the contract.

The Nova Scotia coal mines are producing steam coal of such excellent quality that the Admiralty will in future use it for the squadron at Halifax instead of importing Welsh coal.

An important discovery of iron has been made at Steep Rock Lake, a station on the Canadian Northern railway between Port Arthur and Fort Frances. It is thought to be a continuation of the Atik-Okan deposit.

METAL SAWING MACHINE.

The machine here illustrated is designed to meet all the requirements of a power machine for sawing metal, and embodies many new features which cannot fail to be appreciated. The upper arm of the frame can be extended so that work as large as 8½ x 12 inches can be cut; the jaws holding the work are planed and can be set so that work on any required angle, as well as straight sawing, can be done. The machine has an 8-inch stroke with quick return; by loosening the set screw in the stud holding the connecting rod, the frame can be swung to either side; by this adjustment the saw can be made to cut perfectly straight; the lower arm of the frame passes through a hole in the sliding thimble with a projecting stud, to which the connecting rod is attached, and on which friction nuts are placed; a set screw runs through this stud and holds the frame in any set position; a piece of steel with concaved end is placed under the set screw to prevent the point from coming in contact with the arm. The slide in which the thimble runs is split so that any wear can readily be taken up by tightening the screws at each end. There is no drag on the saw during the backward movement. By adjusting the friction on the connecting rod the saw can be made to lift gently from the work when



going backward, and the pressure on the forward stroke can be increased or diminished by the same means. A coil containing twenty-five feet of saws is placed in the magazine on the rear end of the arm, and can be drawn through the proper distance for the work being sawed. By using the magazine coil principle the saws can be used their entire length, instead of only in the centre, as on non-adjustable frames using blades of a fixed length. This feature alone reduces the cost of saws fully one-half, and as the saw is firmly clamped at both ends instead of being held by pins, the danger of the holes being pulled out of the ends of blades is entirely obviated. The saw can be made to cut faster or slower by putting on or taking off the weights on the rod attached to an arm on the rear end of the machine. After a cut is finished the clutch is automatically thrown out, and the machine is stopped. The machine is furnished with countershaft, self-oiling adjustable hangers, tight and loose pulleys, 10-inch diameter by 3-inch face, driving pulley 6-inch diameter by 4-inch face, and should make 110 revolutions per minute, giving 40 cuts per minute to the saw. Weight of machine, 500 lbs., floor space required, 2 by 6 feet; size of pulley on machine, 16-inch diameter, 3-inch face. The makers of this machine, Henry G. Thompson & Sons, New Haven, Conn., are the originators of the flexible back lock saws, and their Yankee, Eureka and I.X.L. blades can be purchased from the leading dealers in Canada. Sample blades are sent free for trial.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The ordinary meeting of the society was held, October 24th, G. H. Duggan, vice-president, in the chair. The following applications for admission and transfer were announced: For admission, J. T. Child, A. C. Dennis, T. A. MacLean and S. Gagne. For transfer from the class of associate member to the class of member, J. W. LeB. Ross. For transfer from the class of student to the class of associate member, C. J. Armstrong, Beaudry Leaman and W. M. Scott.

A paper by W. W. Colpitts on the Economics of Railway Improvements, was read by H. Irwin. It was decided to further postpone discussion on Cecil B. Smith's paper on "Discharge of Sewage from Toronto Sewers in 1900."

At the ordinary meeting held November 7th, applications for admission and transfer were announced as follows: For admission, H. N. Putnam. For transfer from the class of student to the class of associate member, J. B. Goodwin.

J. G. G. Kerry spoke in discussion of Mr. Colpitts' paper. Further discussion of this paper was postponed until a later meeting.

It was resolved that C. B. Smith's paper on "Discharge of Sewage from Toronto Sewers in 1900," should be read at an early meeting for the purpose of discussion, and that a notice of the proposed discussion should be sent to the persons interested.

Dr. E. G. Coker addressed the meeting giving an account of his investigations in connection with Dr. H. T. Barnes on "The Determination of the Critical Velocity of water."

At the meeting on the 21st November, H. Irwin in the chair, it was announced that the annual meeting of the society would take place on Tuesday, Jan. 28th and following days. A special committee has in hand the development of a programme for the meeting.

F. P. Shearwood, of the Dominion Bridge Company, read a paper descriptive of the superstructure of the interprovincial bridge recently erected between Hull and Ottawa.

A ballot was opened, as a result of which the following members were declared elected: Members, James T. Child, Regina, N.W.T.; A. C. Dennis, Winnipeg; J. S. Dennis, Regina, N.W.T.; Associate members, H. A. Bayfield, Montreal; L. W. Gill, Kingston; H. L. Jordan, Quebec; R. H. Parkinson, Fairview, B.C.; H. A. Rowe, Webbwood, Ont.; A. W. H. Stimpson, Ottawa; W. V. Taylor, Gananoque, and J. H. Wallace, New York. Associate, E. M. Quirk, Montreal. Transferred from the class of Associate Member to Member, A. H. N. Bruce, Rat Portage; A. J. Grant, Coteau Landing; M. W. Hopkins, Rat Portage; J. W. L. Ross, Cardinal; C. C. Worsfold, New Westminster, B.C. Transferred from the class of Associate to Associate Member, H. F. Duck, Toronto. Transferred from the class of Student to that of Associate Member, C. W. Archibald, Truro, N.S.; A. J. McPherson, Brockville.

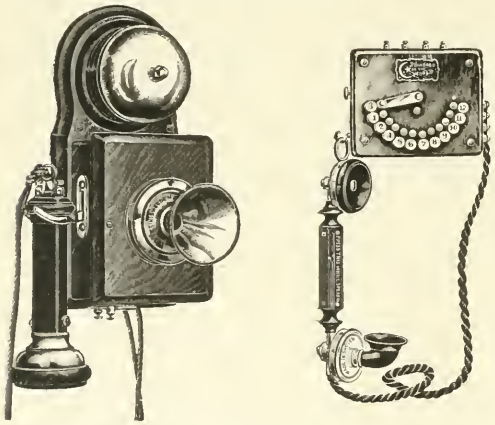
Students, K. M. Cameron, London, Ont.; Donald J. Carter, Montreal; A. R. Chipman, St. Stephen, N.B.; R. H. Harcourt, Welland; G. B. Hughes, Lindsay; T. C. Keefer, jr.; Ottawa; C. C. McLennan, Toronto; F. H. Maynard, Ottawa; J. M. Mundie, Kingston; H. F. Osler, Toronto; J. M. Oxley, Montreal; W. F. Sparrow, Montreal, and A. Stewart, Kingston.

The Toronto and Hamilton Electric Railway Co. will apply for incorporation at the next session of the Ontario Legislature. They ask powers to construct an electric railway between the cities named, also telegraph and telephone lines.

W. T. Groffe, a newspaper man, formerly of Toronto and Montreal, now of Knoxville, Tennessee has obtained the franchise for 54 miles of electric road to connect Knoxville with neighboring towns. He is trying to interest Canadian capital in the project.

TELEPHONE SYSTEMS IN PRIVATE HOUSES.

The private house of to-day, instead of being equipped with a speaking tube as was the custom a few years ago, generally has a modern telephone system connecting the various departments with each other. The main advantage of the telephone over the speaking tube is that one outlet or one phone can be used to communicate to all of the different stations, whereas when the speaking tube was used, a separate mouth piece was needed for each and every station. In locating these outlets for the telephone, great care should be taken in placing them where they will be most convenient for the use of the household, and also where they will not interfere with any of the fittings of the house which are to be installed at a later date, such as radiators, sideboards, etc. A very convenient place is near the casing of the door, as it is almost impossible to place any heavy article of furniture near a door. Caution should be used in first discovering which way the door is to swing. The wire cable which is used in connecting the various stations should run as far from the water pipes as possible, on account of breaks in the pipes which are liable to occur, and the moisture from which would injure the wires, make cross-connection, cause leaks of current and soon destroy the vitality of the battery. A cable having a weather-proof insulation is preferable, not only



on account of the properties which prevent moisture from entering the same, but also because a cable of this kind is not attacked by rats or mice. These animals gnaw the insulation, and while they do not injure the wires, in the ordinary cable they frequently cause crossing or grounding of wires which is difficult to locate, and is very annoying both to the owner and the electrician. Wall pockets or receptacles for holding the telephone are very useful at the outlets, for while keeping the telephones fully covered, they do not deface the walls, and by their use many of the connections can be made inside and a buzzer or a bell can be placed within for the purpose of calling that station. The telephone itself can be very small and compact, and by using the hand microtelephone in connection with a selective switch (see cut), an instrument having capacity of fifteen stations will occupy a space of only four or five inches square. Woodwork in special design and finish is often used to match the finish of the room, and thus the telephone can be made an ornament as well as a great convenience. In some mansions the wooden cases have been made of solid ebony, rosewood or other costly woods, while the metal parts have been gold plated. There is no limit to the flexibility of a system of this description, as any station can call all the departments or it can be so wired as to call only a certain few. Arrangements should be made for bringing the cable to a point where it can be attached to wires going to the table, greenhouse, etc., these connections being especially convenient for the lady of the house, as in ordering the carriage for a drive, etc.

By a simple attachment in the owner's chamber, the telephone system can be instantly converted into an alarm system, and all the bells be made to ring at one time by the simple pressure of a special lever. This can be used in case of fire, burglars or sickness, and is very valuable in suburban residences. As to the construction, the cable itself should be installed while the house is in process of construction and should be put in place before the studding is covered with lath and plaster. The instruments themselves should not be placed on the wall until all the workmen have left the building for good, as telephones are apt to be regarded as an object of curiosity by workmen doing other work, and oftentimes considerable damage is done by their carelessness. We show two simple instruments which are well adapted for household purposes, and are reasonable in cost. These and other patterns can be obtained from the Ericsson Telephone Co., No. 296 Broadway, New York City, who sell their telephones outright and subject to no rental or other charges. The use of telephones in all the finer residences and apartments is only a question of time, and once used people will insist on having them because they save so much time.

ENGINEERS' CLUB OF TORONTO.

Two meetings of the Engineers' Club, of Toronto, were arranged for November. On the 5th, the Toronto waterworks conduit was to be discussed, but as there was a bare quorum present it was laid over for a future occasion. The meeting on the 21st was of a purely business character. The programme for December contains two meetings, one on the 3rd, at which a paper on Wireless Telegraphy is to be read by Prof. Rosebrugh, and one on the 19th, at which W. H. Patton is to take up Interlocking Railway Signals.

Eusebe Faille, a workman in the Star Iron Works, Beauharnois, had his brains dashed out by the bursting of an emery wheel. The deceased accidentally dropped a chisel which jammed the wheel. The factory regulations should provide that all emery wheels should have cast iron or sheet steel hoods, as they have in other countries.

The Mica Boiler Covering Co., Ltd., of Montreal, announce that they have been appointed sole agents for Canada for Straus' boiler compound "Boilorine." They intend keeping a quantity of "Boilerine" in stock, and will forward catalogue and price list to those interested. They are also dealers in engineers' supplies, and are agents for the Springvale Yellow Axle Grease. Mica covering won the only gold medal in its section at the Pan-American Exposition.

LITERARY NOTES.

A welcome addition to our exchange list is the American Blacksmith, published monthly at 210 Pearl street, Buffalo, at $1 a year. There are probably more unsolved problems connected with blacksmithing than with any one department of iron working, and if the character of the first two numbers is maintained our new contemporary will prove a successful teacher to the toilers in this historic trade. The November number gives as a good example of hammered iron work, two illustrations of the balustrade of the grand stairway of Toronto city hall, made in the ornamental fence and iron department of the Canada Foundry Co.

Under the title of "Canada under Victoria," John A. Cooper, editor of the Canadian Magazine, has reprinted for private circulation, four chapters which he contributed to a recent volume on "Queen Victoria." The little volume is not so much a study of our late Queen as a review of the progress of Canada during her wonderful reign, but in this review Mr. Cooper has presented in graphic style many striking facts not commonly known to, or at least well remembered by, the average Canadian.

The new edition of Webster's International Dictionary, printed from new plates throughout, contains 25,000 additional words, and makes a royal quarto volume of 2,364 pages. It has 5,000 illustrations, and it has fully earned the

title of "international," for it has made its way steadily in Great Britain as well as in Canada. As a work of reference in one volume nothing like it has been compiled in the English language. To those interested in the new work sample pages and information will be sent by addressing G. & C. Merriam Co., Springfield, Mass.

The Gas Engine Publishing Co., Cincinnati, O., have made a useful contribution to technical literature in "How to Build a Three Horse-Power Launch Engine," the latest work by E. W. Roberts, the author of "The Gas Engine Handbook." The present work gives a full set of working drawings with explanatory text on the construction and operation of a 3-h.p. gasoline marine engine. In this work the author has first made a complete set of shop drawings, nearly all of them full size, and then reduced them to make the plates in the book. The details are given for each separate part in nearly every instance with full dimensions, and in several cases an assembled drawing is given as well. The engine has been designed primarily for construction with such tools as are usually found in the average machine shop, and no piece, except the fly-wheel, which is 18 inches in diameter, requires a lathe of over 16 inches. Every part of the design has been computed according to the rules and the formulas laid down in the Gas Engine Handbook, and the engine shows the general proportions given by these rules. While a great many of the small marine engines are the two-cycle type, it is notorious that a great many machinists who have had no experience with the two-cycle engines get into trouble when they build them. Therefore, the author has designed a four-cycle for this purpose, believing that it will give better satisfaction. The price of this work is $2.50, and for the accommodation of those who desire working drawings on a larger scale, the publishers have arranged to supply blue prints from the original tracings at an additional cost of $4 when purchased with the book, or $4.50 when purchased separately.

The Institution of Mining Engineers have published the report of the joint committee of the North of England Institute and Mechanical Engineers and the Midland Institute of Mining, Civil and Mechanical Engineers on the subject of "Mechanical Ventilators," as applied to colliery work. The report makes a volume of 96 octavo pages, besides 31 plates. The trials were made with the Guibal, Schiele and the Waddle ventilators. The report is edited by M. Walton Brown, Neville Hall, Newcastle-on-Tyne.

In a little pamphlet prepared by H. Wade Hibbard, Professor of Railway Mechanical Engineering in Sibley College, Ithaca, N.Y., there are some good thoughts as well as practical hints on the use of engineering periodicals, and the preservation of practical data by means of the card index. It is one of the great problems of the student in engineering how to preserve information so as to be able to use it when wanted, and the hints here contained are good. We understand this essay will be sent without charge to our readers who are interested.

Tide tables for the British Columbia coast for 1902 have been issued by the Department of Marine, Ottawa, who will also issue similar tables for the eastern Maritime provinces.

Compressed Air; Its Production, Uses and Applications. By Gardner D. Hiscox, M.E. New York: Norman W. Henley & Co., 132 Nassau street; 1901; 820 pp., 40 air tables and 545 illustrations. Price, $5. This is an exhaustive treatise, sumptuously illustrated. The author is well known in connection with his works on Mechanical Movements, Gas Engines, Horseless Vehicles, etc. The history of Compressed Air forms an interesting chapter, and the author tells how in 1862 he made plans for a light car street railway system with compressed-air storage under the seats and on top of the car, with the engine under the platform, the air pressure of 250 lb. to be supplied from station storage tanks and a compressor on the line. But "the plans did not meet with financial encouragement and proved to be premature. The horse was not yet ready to go. Another generation was needed to bring compressed air power for railways to a financial acceptance." The book gives illustrations of the Hardie compressed-air street railway system, now in operation in New York and Chicago, Hardie having improved on the Mekarski system which operates in Marseilles, France, and Berne, Switzerland. This system, the author states, gives absolutely smooth and noiseless motion with total absence of smoke, steam or heat. In France the pressure is 1,200 lbs. to the square inch. Pneumatic work in all its ramifications is dealt with in a lucid way; there being cuts of motors, mining, marine work, painting, pyrometry, riveting, sand-sifting, air-brakes, whistles, basket making, fog signals, dredging, blast furnace, rolling mill, store and office pneumatic systems, sewage discharge, gold extracting, wood vulcanizing, aging of liquors, refrigeration by vacuum, liquid air phenomena, etc. The relation of gas and kerosene engines to compressed air is dealt with. The hydraulic compressor system of our fellow-Canadian, Mr. C. H. Taylor, at Magog, Que., and Ainsworth, B.C., and which was first described in The Canadian Engineer, is touched upon. The author says: "A most remarkable feature of this system is that, notwithstanding that the air is compressed by the weight of the water, and in actual contact with it, the air so compressed is delivered in the receiver and thence to the transmission pipe drier than when drawn in from the atmosphere. . . Another feature is that the power of the water can be converted into compressed air at any pressure per square inch, giving the same efficiency at either high or low pressure with a far less loss of energy than by any other process of transforming a water power into transmittable force and with unvarying pressure. . . By this system low falls, otherwise useless, may be utilized, and the same pressure obtained as from high falls. The list of patents on compressed-air and pneumatic appliances makes a useful addition to the work.

STATIONARY ENGINEERS.

The 15th annual banquet of the Canadian Association of Stationary Engineers No. 1, took place at the Walker House, Toronto, on Thanksgiving eve. Over 200 were present. The following toasts were honored: "The King," "Ontario the Banner Province," responded to by the singing of the "Maple Leaf;" "Toronto the Queen City," by Ald. Frame and ex-Ald. J. Orr; "Our Guests," by Thomas Elliott, of the Dominion Copper Co., of Hamilton, Joseph Ironsides, of the Queen street Pump House of Hamilton, O. P. St. John, inspector of boilers; "Our Manufacturers," by James Lister, of the Pure Gold Manufacturing Co., J. J. Main, of the Heine Boiler Co., M. Sinclair, of the Eureka Mineral Wool Co.; "Our Educational Interests," by Dr. J. O. Orr, John Galt, C.E., and "The Executive," by Chas. Moseley and A. M. Wickens. During the evening songs were sung by Walter Anderson, Harry Brown, W. G. Blackgrove, R. A. L. Gray and William Cairns.

The Banquet Committee were: H. E. Terry, chairman; James Bannan, secretary-treasurer; Wm. Webb, G. C. Mooring, A. M. Wickens, N. V. Kuhlman, W. Clark, W. N. Outhwaite and R. H. Johnston. The banquet was the best in the history of the association.

A POWERFUL DREDGE.

The largest and most powerful hydraulic dredge ever built, named after the Minister of Public Works for Canada, J. Israel Tarte, was given an official test in Toronto harbor on Nov. 26. The dredge was designed by A. W. Robinson, S.C.E., of Montreal, a Canadian mechanical engineer, who has designed over 100 dredges of various kinds. The hull is of steel, 160 feet long, 42 feet wide, and 13 feet deep. There are triple expansion engines of 1200-h.p., which drive a large centrifugal pump, also a pair of double tandem compound engines of 300-h.p. to work a cutter weighing 10 tons, which operates at the lower end of a gigantic suction pipe of 40 inches diameter. This pipe passes through an opening in the centre of the dredge. The capacity of the main pump is 75,000,000 gallons per 24 hours, and it can dredge clay from a depth of 50 feet. The work of the dredge is equal to about 2,000 cubic yards per hour, which means that 3,000 tons of

solid matter can be dredged from a depth of 50 feet and delivered 2,000 feet away through a discharge pipe, which in the test was supported on the surface of the water by steel pontoons. Electric lighting is provided, and cabins for the crew.

The dredge was built by the Polson Iron Works Co., for the Dominion Government. The test was eminently satisfactory. It will winter in Toronto, and next season will be employed in deepening and widening the channel between Montreal and Quebec.

Miscellaneous Notes.

Oil has been found at Aylmer, Ont., at a depth of 270 feet

The Yukon mines employ 5,280 men according to last census.

The Bruce Mines, which closed down some time ago, will not re-open.

The Dominion Coal Co. has closed the International mine for the winter.

There is renewed activity in mining operations in Northwest Ontario, also at Marmora.

J. R. Booth will erect next year a large pulp mill on the McKay mill site at Ottawa.

A steel bridge has been placed in position over theMadawaska River at Calabogie, on the line of the C.P.R.

The Canada Atlantic Railway, which already has a 1,500,000 bushel elevator at Depot Harbor, will erect a 2,000,000 bushel annex.

A very rich find of copper is reported on the Lake Superior Copper Co.'s property near the Sault. It is said $5,000,000 worth is in sight.

The contract for laying an American cable to Hawaii has been awarded to an English firm for a sum in the neighborhood of $3,000,000.

Hamilton is asked to give right of way, and take stock to the extent of $25,000 in a proposed electric road from Hamilton to Caledonia.

Christ Church Cathedral, Montreal, has been presented with funds for a complete up-to-date electric light plant, which is to be installed forthwith.

An agitation has been started in Newfoundland for a royalty on Bell Island iron ore, as the companies are making a profit of 70 cents a ton.

The contract for the Lenora smelter at Osborne Bay, B.C., has been awarded to Fred. Sherbourne, of Victoria. It will have a capacity of 300 tons a day.

W. D. Mathews, of Toronto, one of the directors of the Canadian Pacific Railway, is the authority for the statement that an electric road will in the near future be built from Toronto to Detroit, Mich.

Gordon, Ironsides & Fares are adding to their abattoir at Winnipeg a complete up-to-date lard refinery, which was manufactured by William R. Perrin & Co of Toronto, who have had large experience in this class of work.

William R. Perrin & Company, who are the largest manufacturers of packing house machinery in Canada, have secured the contract for fitting the new plant being erected by the Laing Packing & Provision Co., in Montreal.

City Engineer Rust, of Toronto, has called the attention of the city council to the fact that the south side of the island is wearing away more rapidly since the piers at the eastern gap were extended. The Government will be asked to place groynes to arrest this tendency.

A new 30-inch water main in Hamilton in use for a few weeks, is reported by Engineer Barrow to have accomplished the following benefits: A friction loss of 15 pounds has been wiped out; there is a decrease of 20 pounds on the pumps, saving fuel; the strain on the pumps is lessened, and the velocity in the 18 and 20-inch mains reduced.

Jas. Gallivan, engineer, of Kingston, is dead.

J. K. Starley, the inventor of the safety bicycle, died at Coventry, Oct. 29.

The lock at Port Carling, Muskoka, is to be enlarged this winter from 133 feet to 170 feet long.

The Stanley is to be placed this winter on the route between Cape Tormentine and Summerside, P.E.I.

Col. Anderson, chief engineer of the Marine Department, has selected sites for eleven new lights between Montreal and Quebec.

A fabulously rich gold strike is reported from Pine Creek in the Atlin country. The quartz is said to run from $1,000 to $5,000 a ton.

A steam ferry across Rainy River at Fort Francis is to be established. T. E. Connors, engineer, has been in Duluth to purchase an engine and boiler. The boat is to be 40 feet long by 10 feet beam.

John Lawson, the oldest railway engineer in America, if not in the world, is dead. He was an apprentice under George Stephenson the great English inventor of the locomotive.

Council No. 1, Marine Engineers, met in Toronto, Nov. 28, and endorsed the action of the Government in refusing to allow United States vessels to carry Canadian grain between Canadian ports for the remainder of this season.

R. H. Buchanan & Co., Craig street, Montreal, report that they are importing some of the largest rolls of belting ever handled in Canada. They have now to carry a large stock of this Rossendale belting, owing to the increasing demand for these goods, which are adapted for main drives, counter belts, etc. The firm has issued a new price list for these goods.

As illustrating the progress of the independent telephone movement referred to in articles in our last and current issues, the Colwell Mnfg. Co., of Toronto, in their advertisement of telephone apparatus in this number, mention that there are 38 local telephone companies in Canada outside of the Bell system. The Colwell Mnfg. Co. have been very successful in equipping these local systems.

The Canadian Rubber Company have for the past three years been testing in actual use in the hands of all classes of manufacturers a high grade red rubber packing for high pressure work. In its perfected condition they are now prepared to recommend it for all steam joints where effective work is a desideratum. It is known as "C. R. Co." Red Packing, and has black stars with letters C. R. Co. on every foot. It can be procured from the trade or from their warehouse in Montreal, Toronto and Winnipeg.

The Canadian General Electric Co. has been awarded the contract for 50 new street lights at Peterboro. They are known as series alternating differential arc lamps, each having its own constant current transformer to take the current direct from the main wire. Each lamp will be 500 candlepower, and the light will be in an enclosed flat globe, opalescent in color. They will burn all night, and only require to be recarboned every four or five days. New transformers are also being installed, three of very large size, to obviate the difficulty of flickering. They weigh about one ton each. A new sub-station is also being built.

The employees of Jas. Warnock & Co., proprietors of the Galt axe factory, to the number of 75, held their annual re-union recently, and enjoyed a pleasant time together. A number of very witty speeches were delivered. George Fairgrieve, the shop superintendent, read a number of telegrams of regret, which were said to have been received. They are worth repeating: "Would like to be with you, but am prevented; am recalling Mabee pamphlet."—G. W. Ross. "Am delighted and honored that you have named your latest gear after me."—Duke of York, Prince of Wales. "Sorry that I can't be with you, but am figuring on a big job for the spring; can't spare a night off."—J. H. Whitney. F. H. Hayhurst, the manager, was presented with a sugar beet grown in Galt, as a reminder of his efforts to secure a beet sugar factory for the town.

TA
1
C34
v.7-8

The Canadian engineer
1849-1901

~~Physical~~
~~Applied Sci.~~
~~Service~~

Engineering

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

ENGIN STORAGE